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Jackson et al.

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(45) **Date of Patent:** ***Jan. 5, 2016**

(54) **PATIENT POSITIONING SUPPORT STRUCTURE**

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(73) Assignee: **Roger P. Jackson**, Prairie Village, KS (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 125 days.

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

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A61G 13/02 (2006.01)
A61G 13/04 (2006.01)

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(52) **U.S. Cl.**
CPC ***A61G 13/04*** (2013.01); ***A61G 13/0036*** (2013.01); ***A61G 13/06*** (2013.01);

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(58) **Field of Classification Search**
CPC A61G 13/04; A61G 13/06; A61G 13/08
USPC 5/607–613, 618, 621
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

377,377	A	2/1888	Ferry
1,098,477	A	6/1914	Cashman

(Continued)

FOREIGN PATENT DOCUMENTS

CN	2467091	Y	12/2001
GB	569758		6/1945

(Continued)

OTHER PUBLICATIONS

Brochure of OSI on Modular Table System 90D, pp. 1-15, date of first publication: Unknow.

(Continued)

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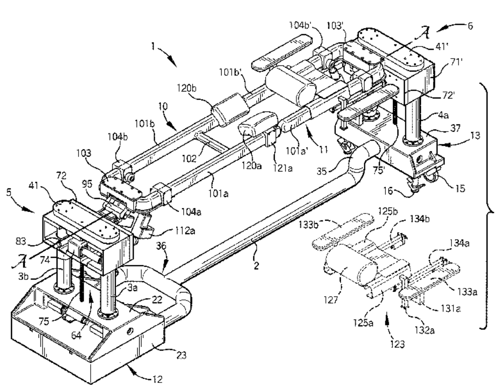
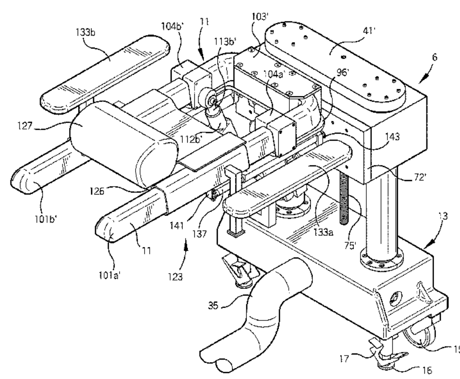
(57) **ABSTRACT**

A patient support structure includes a pair of independently height-adjustable supports, each connected to a patient support structure. The supports may be independently raised, lowered, rolled or tilted about a longitudinal axis, laterally shifted and angled upwardly or downwardly. Position sensors are provided to sense all of the foregoing movements. The sensors communicate data to a computer for coordinated adjustment and maintenance of the inboard ends of the patient support structures in an approximated position during such movements. Longitudinal translation structure provides for compensation in the length of the structure when the supports are angled upwardly or downwardly. Patient translation structure provides coordinated translational movement of the patient's upper body along the respective patient support in a caudad or cephalad direction as the support structures are angled upwardly or downwardly for maintaining proper spinal biomechanics and avoiding undue spinal traction or compression.

49 Claims, 17 Drawing Sheets





Related U.S. Application Data

is a continuation of application No. 11/788,513, filed on Apr. 20, 2007, now Pat. No. 7,565,708, which is a continuation-in-part of application No. 11/159,494, filed on Jun. 23, 2005, now Pat. No. 7,343,635, which is a continuation-in-part of application No. 11/062,775, filed on Feb. 22, 2005, now Pat. No. 7,152,261.

(60) Provisional application No. 60/798,288, filed on May 5, 2006.

(51) **Int. Cl.**
A61G 13/00 (2006.01)
A61G 13/08 (2006.01)
A61G 13/06 (2006.01)

(52) **U.S. Cl.**
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(56) **References Cited**

U.S. PATENT DOCUMENTS

1,171,713 A 2/1916 Gilkerson
1,528,835 A 3/1925 McCullough
1,667,982 A 5/1928 Pearson
1,780,399 A 11/1930 Munson
1,799,692 A 4/1931 Knott
1,938,006 A 12/1933 Blanchard
2,188,592 A 1/1940 Hosken et al.
2,261,297 A 11/1941 Frederick
2,475,003 A 7/1949 Black
2,636,793 A 4/1953 Walter Meyer
2,688,410 A 9/1954 Nelson
2,792,945 A 5/1957 Brenny
3,046,071 A 7/1962 Shampaine et al.
3,049,726 A 8/1962 Getz
3,281,141 A 10/1966 Smiley et al.
3,584,321 A 6/1971 Buchanan
3,599,964 A 8/1971 Magni
3,766,384 A 10/1973 Anderson
3,814,414 A 6/1974 Chapa
3,832,742 A 9/1974 Stryker
3,988,790 A 11/1976 Mracek et al.
4,101,120 A 7/1978 Seshima
4,131,802 A 12/1978 Braden et al.
4,144,880 A 3/1979 Daniels
4,148,472 A 4/1979 Rais et al.
4,175,550 A 11/1979 Leininger et al.
4,186,917 A 2/1980 Rais et al.
4,227,269 A 10/1980 Johnston
4,230,100 A 10/1980 Moon
4,391,438 A 7/1983 Heffington, Jr.
4,474,364 A 10/1984 Brendgord
4,503,844 A 3/1985 Siczek
4,552,346 A 11/1985 Schnelle et al.
4,712,781 A 12/1987 Watanabe
4,718,077 A 1/1988 Moore et al.
4,763,643 A 8/1988 Vrzalik
4,771,785 A 9/1988 Duer
4,872,657 A 10/1989 Lussi
4,887,325 A 12/1989 Tesch
4,937,901 A 7/1990 Brennan
4,944,500 A 7/1990 Mueller et al.
4,953,245 A 9/1990 Jung
4,970,737 A 11/1990 Sagel
5,013,018 A 5/1991 Sicek et al.
5,088,706 A 2/1992 Jackson
5,131,105 A 7/1992 Harrawood et al.
5,131,106 A 7/1992 Jackson
5,161,267 A 11/1992 Smith
5,163,890 A 11/1992 Perry, Jr.
5,181,289 A 1/1993 Kassai
5,208,928 A 5/1993 Kuck et al.
5,210,887 A 5/1993 Kershaw
5,210,888 A 5/1993 Canfield
5,230,112 A 7/1993 Harrawood et al.
5,231,741 A 8/1993 Maguire
5,239,716 A 8/1993 Fisk
5,274,862 A 1/1994 Palmer, Jr. et al.
5,333,334 A 8/1994 Kassai
5,393,018 A 2/1995 Roth et al.
5,444,882 A 8/1995 Andrews et al.
5,461,740 A 10/1995 Pearson
5,468,216 A 11/1995 Johnson et al.
5,487,195 A 1/1996 Ray
5,499,408 A 3/1996 Nix
5,524,304 A 6/1996 Shutes
5,544,371 A 8/1996 Fuller
5,579,550 A 12/1996 Bathrick et al.
5,588,705 A 12/1996 Chang
5,613,254 A 3/1997 Clayman et al.
5,640,730 A 6/1997 Godette
5,645,079 A 7/1997 Zahiri et al.
5,658,315 A 8/1997 Lamb et al.
5,659,909 A 8/1997 Pfeuffer et al.
5,673,443 A 10/1997 Marmor
5,737,781 A 4/1998 Votel
5,754,997 A 5/1998 Lussi et al.
5,774,914 A 7/1998 Johnson et al.
5,794,286 A 8/1998 Scott et al.
5,862,549 A 1/1999 Morton et al.
5,870,784 A 2/1999 Elliott
5,890,238 A 4/1999 Votel
5,901,388 A 5/1999 Cowan
5,937,456 A 8/1999 Norris
5,996,151 A 12/1999 Bartow et al.
6,000,076 A 12/1999 Webster et al.
6,035,465 A 3/2000 Rogozinski
6,049,923 A 4/2000 Ochiai
6,212,713 B1 4/2001 Kuck et al.
6,260,220 B1 7/2001 Lamb et al.
6,282,736 B1 9/2001 Hand et al.
6,282,738 B1 9/2001 Heimbrock et al.
6,286,164 B1 9/2001 Lamb et al.
6,295,671 B1 10/2001 Reesby et al.
6,322,251 B1 11/2001 Ballhaus et al.
6,438,777 B1 8/2002 Bender
6,496,991 B1 12/2002 Votel
6,499,162 B1 12/2002 Lu
6,505,365 B1 1/2003 Hanson et al.
6,526,610 B1 3/2003 Hand et al.
6,634,043 B2 10/2003 Lamb et al.
6,638,299 B2 10/2003 Cox
6,662,388 B2 12/2003 Friel et al.
6,668,396 B2 12/2003 Wei
6,681,423 B2 1/2004 Zachrisson
6,701,553 B1 3/2004 Hand et al.
6,854,137 B2 2/2005 Johnson
6,857,144 B1 2/2005 Huang
6,862,759 B2 3/2005 Hand et al.
6,971,131 B2 12/2005 Bannister
6,971,997 B1 12/2005 Ryan et al.
7,003,828 B2 2/2006 Roussy
7,055,195 B2 6/2006 Roussy
7,089,612 B2 8/2006 Rocher et al.
7,103,931 B2 9/2006 Somasundaram et al.
7,137,160 B2 11/2006 Hand et al.
7,171,709 B2 2/2007 Weismiller
7,189,214 B1 3/2007 Saunders
7,197,778 B2 4/2007 Sharps
7,290,302 B2 11/2007 Sharps
7,331,557 B2 2/2008 Dewert
7,343,635 B2 3/2008 Jackson
7,428,760 B2 9/2008 McCrimmon
7,596,820 B2 10/2009 Nielsen et al.
7,653,953 B2 2/2010 Lopez-Sansalvador
7,669,262 B2 3/2010 Skripps et al.
7,874,695 B2 1/2011 Jensen
8,060,960 B2 11/2011 Jackson
8,381,331 B2 2/2013 Sharps et al.
8,677,529 B2 3/2014 Jackson
8,707,476 B2 4/2014 Sharps

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,707,484	B2 *	4/2014	Jackson et al. 5/611
8,719,979	B2	5/2014	Jackson
8,826,474	B2	9/2014	Jackson
8,826,475	B2	9/2014	Jackson
8,839,471	B2	9/2014	Jackson
8,844,077	B2	9/2014	Jackson et al.
8,856,986	B2	10/2014	Jackson
8,938,826	B2	1/2015	Jackson
8,978,180	B2	3/2015	Jackson
2001/0037524	A1	11/2001	Truwit
2002/0023298	A1	2/2002	Lamb et al.
2003/0055456	A1	3/2003	Cox
2003/0074735	A1	4/2003	Zachrisson
2003/0145383	A1	8/2003	Schwaegerle
2004/0098804	A1	5/2004	Varadharajulu et al.
2004/0133983	A1	7/2004	Newkirk et al.
2006/0016010	A1	1/2006	Weismiller
2006/0080777	A1	4/2006	Rocher et al.
2006/0123546	A1	6/2006	Horton et al.
2006/0185090	A1	8/2006	Jackson
2007/0107126	A1	5/2007	Koch et al.
2007/0169265	A1	7/2007	Saracen et al.
2007/0192960	A1	8/2007	Jackson
2008/0000028	A1	1/2008	Lemire et al.
2009/0126116	A1	5/2009	Lamb et al.
2010/0037397	A1	2/2010	Wood
2010/0192300	A1	8/2010	Tannoury et al.
2011/0099716	A1	5/2011	Jackson
2011/0107516	A1	5/2011	Jackson
2011/0107517	A1	5/2011	Lamb et al.
2012/0144589	A1	6/2012	Skripps et al.
2012/0174319	A1	7/2012	Menkedick
2012/0198625	A1	8/2012	Jackson
2012/0246829	A1	10/2012	Lamb et al.
2012/0246830	A1	10/2012	Hornbach
2012/0255122	A1	10/2012	Diel et al.
2013/0111666	A1	5/2013	Jackson
2013/0133137	A1	5/2013	Jackson
2013/0198958	A1	8/2013	Jackson et al.
2013/0205500	A1	8/2013	Jackson
2013/0219623	A1	8/2013	Jackson
2013/0254992	A1	10/2013	Jackson
2013/0254993	A1	10/2013	Jackson
2013/0254994	A1	10/2013	Jackson
2013/0254995	A1	10/2013	Jackson
2013/0254996	A1	10/2013	Jackson
2013/0254997	A1	10/2013	Jackson
2013/0269710	A1	10/2013	Hight et al.
2013/0312181	A1	11/2013	Jackson et al.
2013/0312187	A1	11/2013	Jackson
2013/0318718	A1	12/2013	Jackson
2013/0318719	A1	12/2013	Jackson
2013/0326812	A1	12/2013	Jackson
2013/0326813	A1	12/2013	Jackson
2014/0020181	A1	1/2014	Jackson
2014/0033436	A1	2/2014	Jackson
2014/0068861	A1	3/2014	Jackson et al.
2014/0082842	A1	3/2014	Jackson
2014/0109316	A1	4/2014	Jackson et al.
2014/0173826	A1	6/2014	Jackson
2014/0196212	A1	7/2014	Jackson
2014/0201913	A1	7/2014	Jackson
2014/0201914	A1	7/2014	Jackson
2014/0208512	A1	7/2014	Jackson
2014/0317847	A1	10/2014	Jackson
2015/0007391	A1	1/2015	Xu
2015/0059094	A1	3/2015	Jackson
2015/0150743	A1	6/2015	Jackson

FOREIGN PATENT DOCUMENTS

GB	810956	3/1959
JP	S53763	1/1978
JP	2000060995	2/2000
WO	9907320	2/1999
WO	0062731	10/2000
WO	WO 00/62731	10/2000
WO	0160308	8/2001
WO	03070145	8/2003
WO	WO 2007/130679 A2	11/2007
WO	2009054969	4/2009
WO	2009100692	8/2009
WO	WO2010/051303 A1	5/2010

OTHER PUBLICATIONS

Brochure of Smith & Nephew on Spinal Positioning System, 2003, 2004.

Pages from website http://www.schaerermayfieldusa.com, pp. 1-5, date of first publication: Unknown.

Complaint for Patent Infringement, *Jackson* v. *Mizuho Orthopedic Sys., Inc* ., No. 4:12-CV-01031 (W.D. Mo. Aug. 7, 2012).

First Amended Complaint for Patent Infringement and Correction of Inventorship, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Sep. 21, 2012).

Defendant Mizuho Orthopedic Systems, Inc.'s Answer to First Amended Complaint and Counterclaims, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Nov. 1, 2012).

Plaintiff Roger P. Jackson, MD's, Reply to Counterclaims, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Nov. 26, 2012).

Roger P. Jackson's Disclosure of Asserted Claims and Preliminary Infringement Contentions, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Jan. 4, 2013).

Second Amended Complaint for Patent Infringement, for Correction of Inventorship, for Breach of a Non-Disclosure and Confidentiality Agreement, and for Misappropriation of Dr. Jackson's Right of Publicity, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Jan. 28, 2013).

Defendant Mizuho Orthopedic Systems, Inc.'s Answer to Second Amended Complaint and Counterclaims, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Feb. 19, 2013).

Defendant Mizuho Osi's Invalidity Contentions Pursuant to the Parties' Joint Scheduling Order, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Feb. 22, 2013).

Plaintiff Roger P. Jackson, MD's, Reply to Second Counterclaims, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Mar. 12, 2013).

Roger P. Jackson, MD's Disclosure of Proposed Terms to Be Construed, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Apr. 5, 2013).

Defendant Mizuho Orthopedic Systems, Inc.'s Disclosure of Proposed Terms and Claim Elements for Construction, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Apr. 5, 2013).

Mizuho Orthopedic Systems, Inc.'s Disclosure of Proposed Claim Constructions and Extrinsic Evidence, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. May 13, 2013).

Plaintiff Roger P. Jackson, MD's Disclosure of Preliminary Proposed Claim Constructions, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. May 13, 2013).

Defendant Mizuho Osi's Amended Invalidity Contentions Pursuant to the Parties' Joint Scheduling Order, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. May 15, 2013).

Joint Claim Construction Chart and Joint Prehearing Statement, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Jun. 7, 2013).

Defendant Mizuho Orthopedic Systems, Inc.'s Objections and Responses to Plaintiff's First Set of Interrogatories, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Jun. 24, 2013).

Defendant Mizuho Orthopedic Systems, Inc.'s Opening Claim Construction Brief, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Jul. 31, 2013).

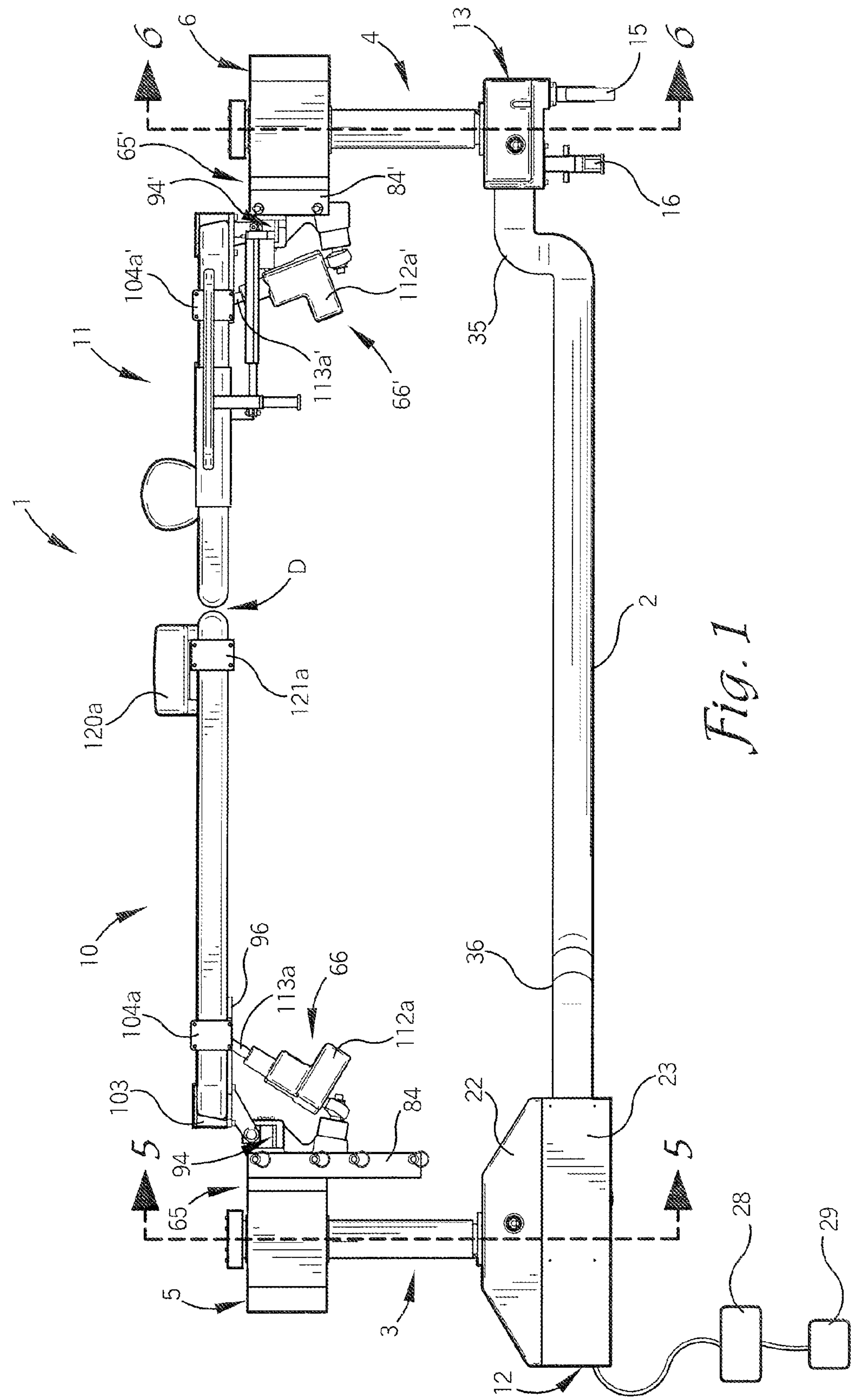
Plaintiff Roger P. Jackson, MD's Opening Claim Construction Brief, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Jul. 31, 2013).

(56) **References Cited**

OTHER PUBLICATIONS

Appendix A Amended Infringement Contentions Claim Chart for Mizuho's Axis System Compared to U.S. Pat. No. 7,565,708, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Aug. 12, 2013).
Appendix B Amended Infringement Contentions Claim Chart for Mizuho's Axis System Compared to U.S. Pat. No. 8,060,960, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Aug. 12, 2013).
Appendix C Amended Infringement Contentions Claim Chart for Mizuho's Proaxis System Compared to U.S. Pat. No. 7,565,708, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Aug. 12, 2013).
Appendix D Amended Infringement Contentions Claim Chart for Mizuho's Proaxis System Compared to U.S. Pat. No. 8,060,960, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Aug. 12, 2013).
Plaintiff Roger P. Jackson, MD's Responsive Claim Construction Brief, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Aug. 16, 2013).
Defendant Mizuho Orthopedic Systems, Inc's Brief in Response to Plaintiffs Opening Claim Construction Brief, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Aug. 16, 2013).
Plaintiff Roger P. Jackson, MD's Suggestions in Support of His Motion to Strike Exhibit A of Mizuho's Opening Claim Construction Brief, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Aug. 16, 2013).
Defendant Mizuho Orthopedic Systems, Inc.'s Opposition to Plaintiffs Motion to Strike, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Sep. 3, 2013).
Transcript of Claim Construction Hearing, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Oct. 11, 2013).
Plaintiff Roger P. Jackson, MD's Claim Construction Presentation for U.S. District Judge Nanette K. Laughrey, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Oct. 11, 2013).
Mizuho's Claim Construction Argument, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Oct. 11, 2013).
Order, *Jackson* v. *Mizuho Orthopedic Sys., Inc*., No. 4:12-CV-01031 (W.D. Mo. Apr. 4, 2014).
Canadian Office Action, CA2803110, dated Mar. 5, 2015.
Chinese Office Action, CN 201180039162.0, dated Jan. 19, 2015.
European Search Report, EP11798501.0, dated Mar. 30, 2015.
Japanese Office Action, JP 2014-132463, dated Jun. 18, 2015.
Japanese Office Action, JP 2014-142074, dated Jun. 18, 2015.
Quayle Action, U.S. Appl. No. 14/792,216, dated Sep. 9, 2015.

* cited by examiner



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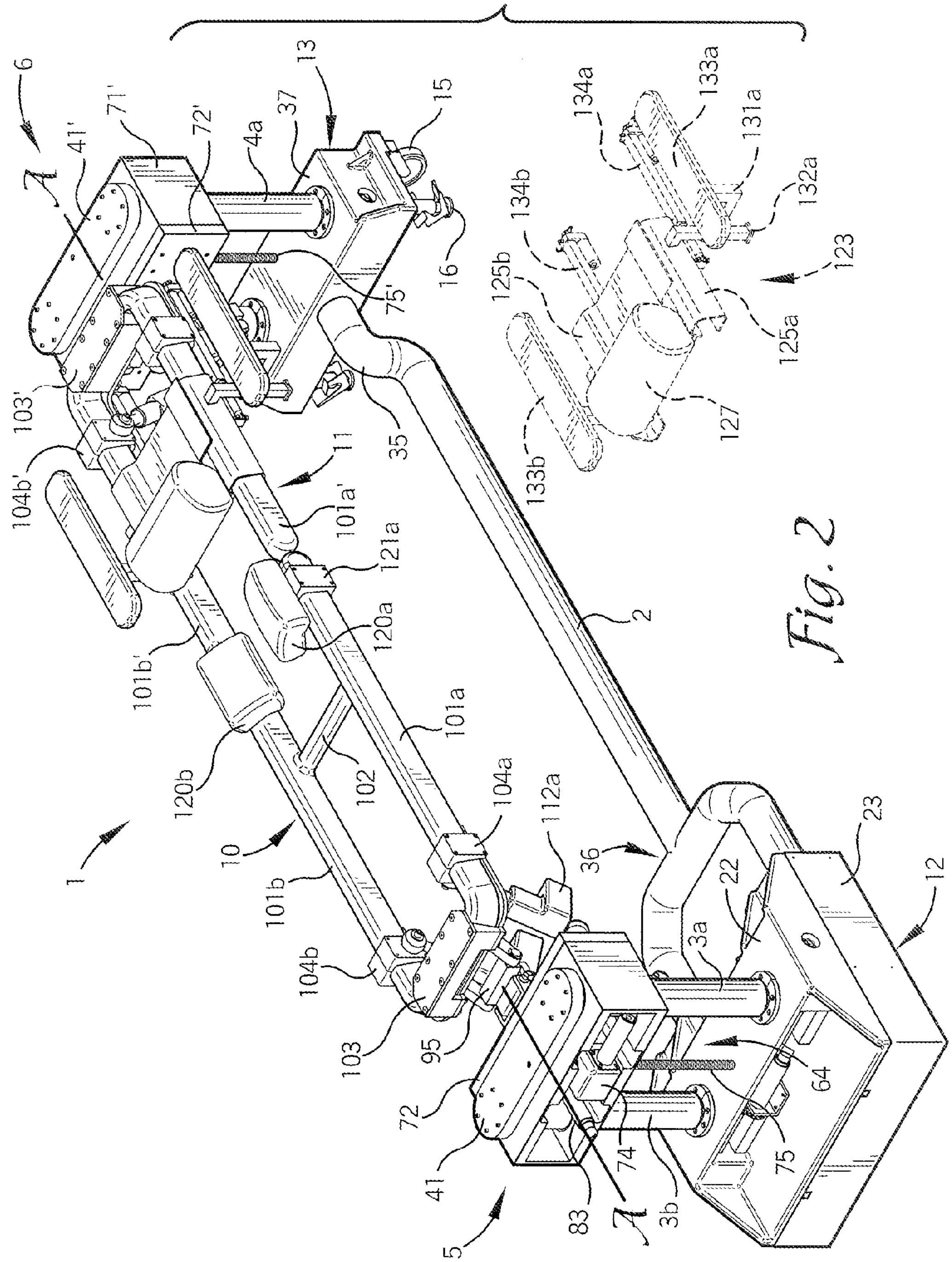
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Fig. 2

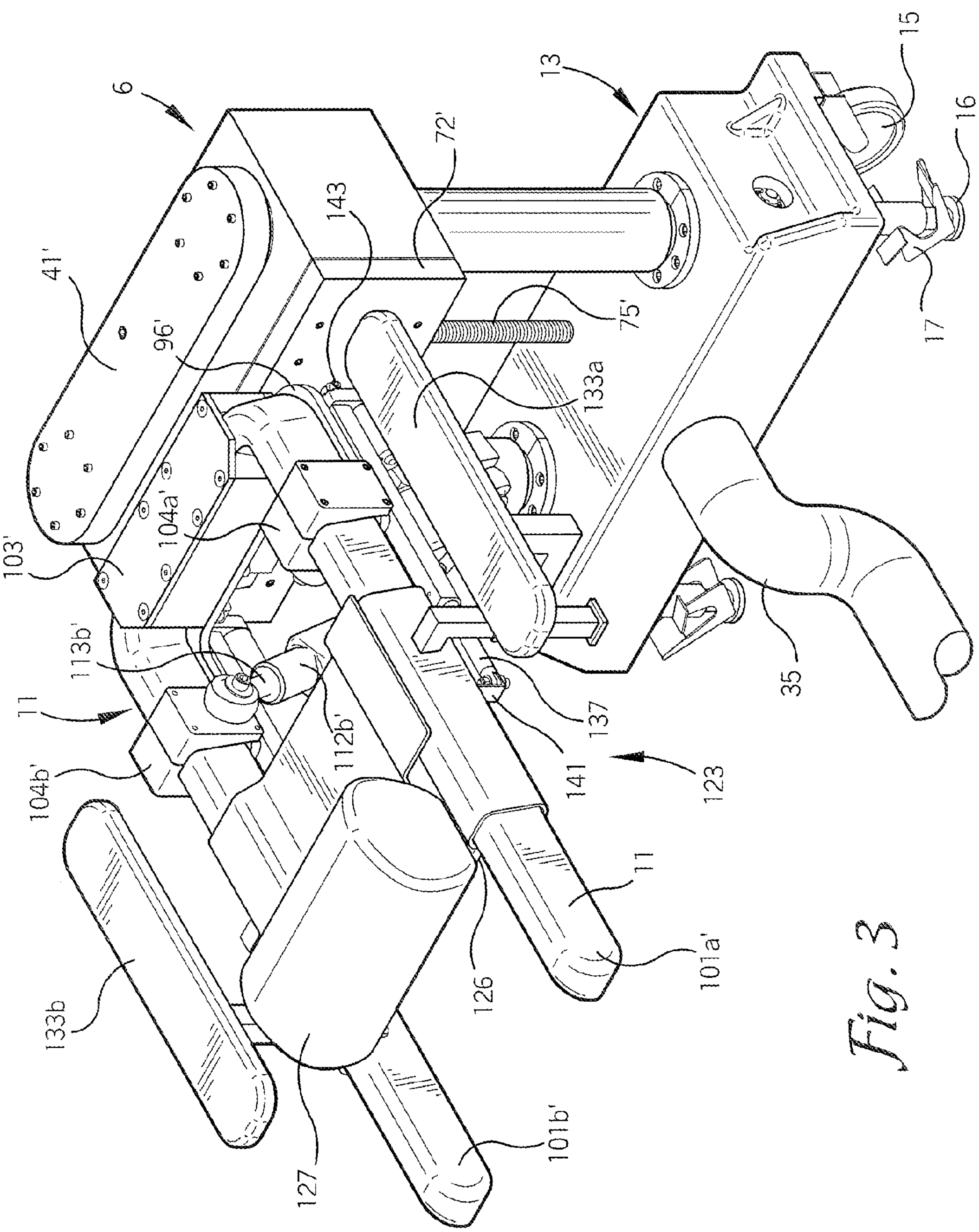
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Fig. 3

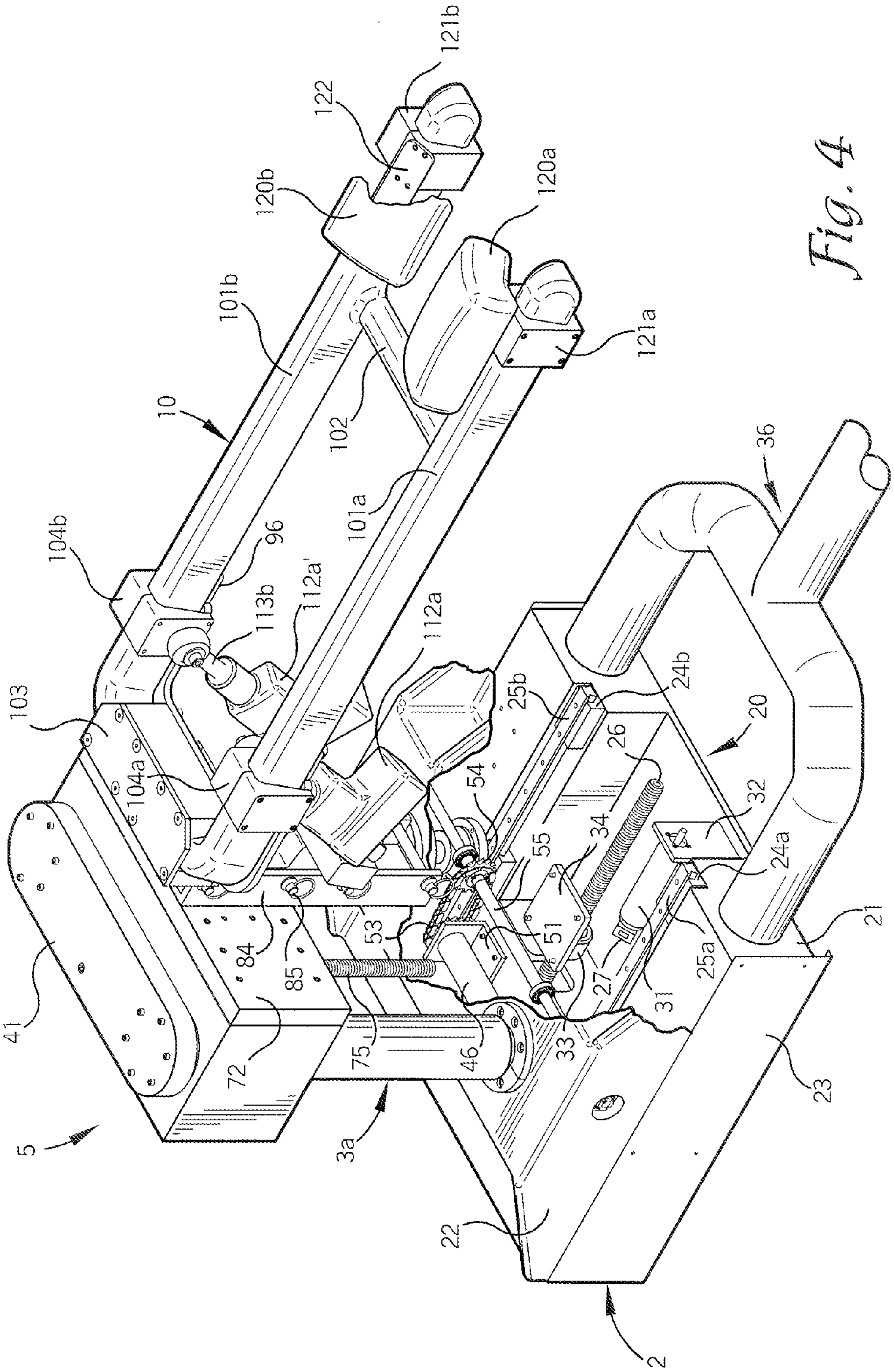
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Fig. 4

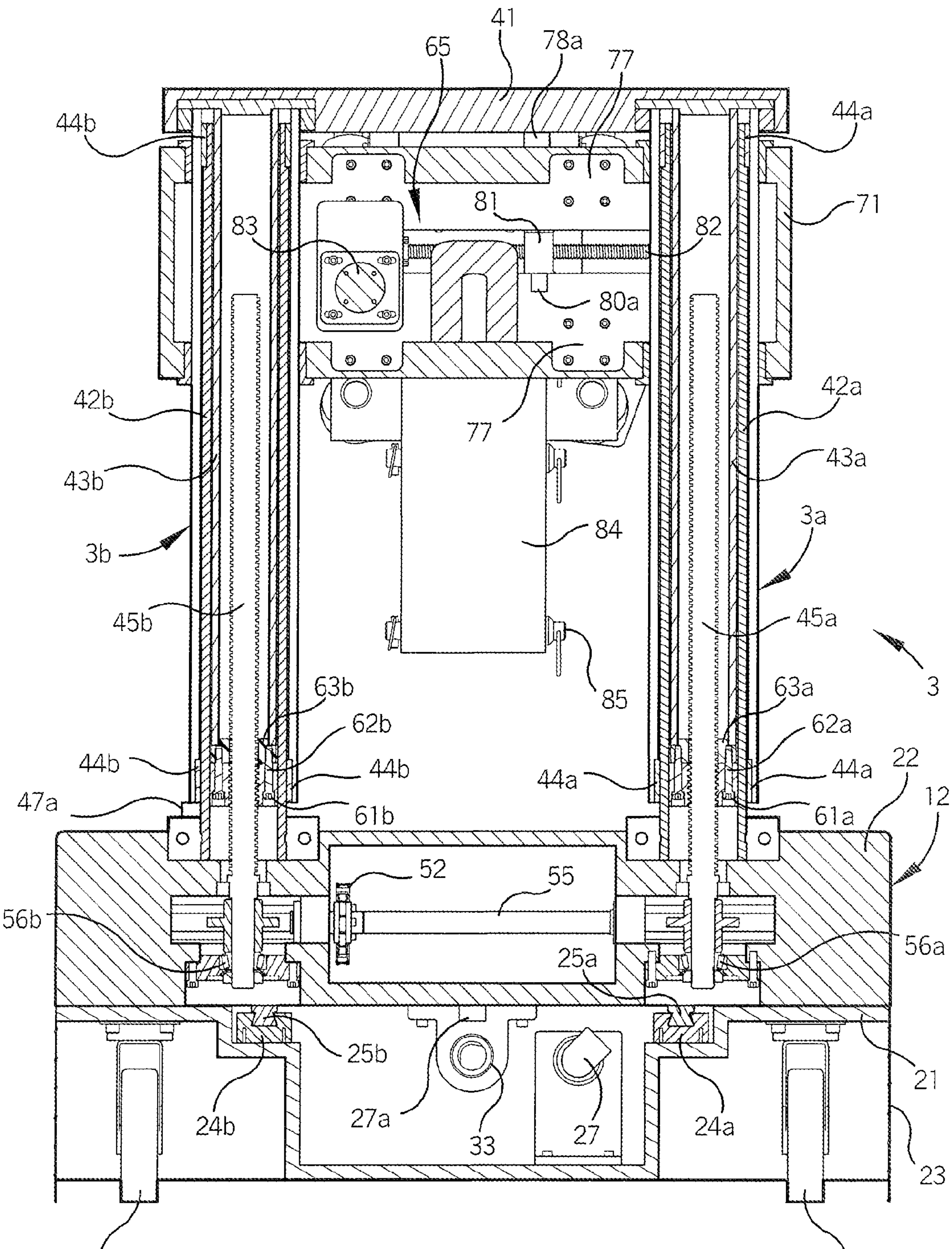
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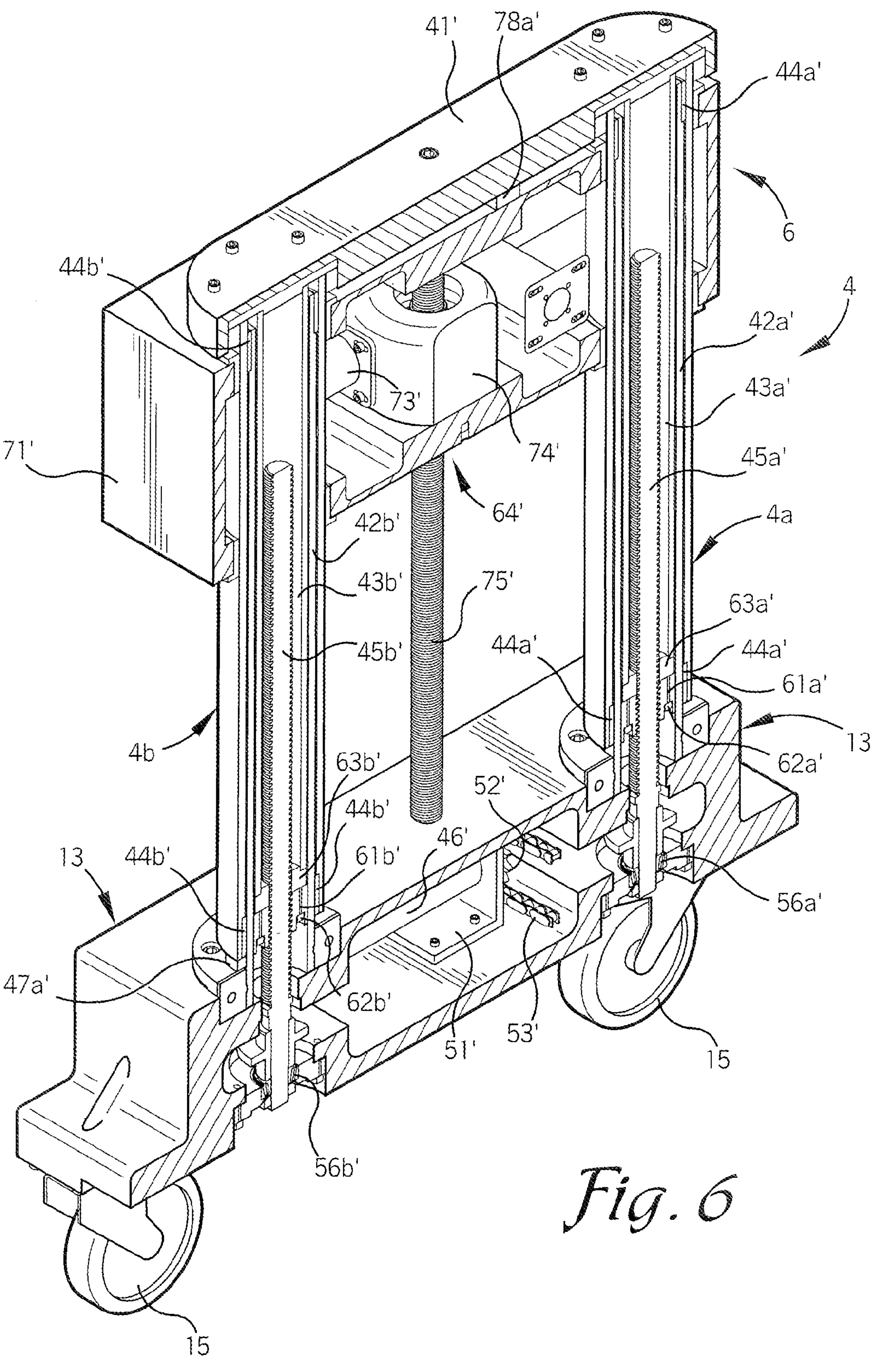
Fig. 5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15

Fig. 6

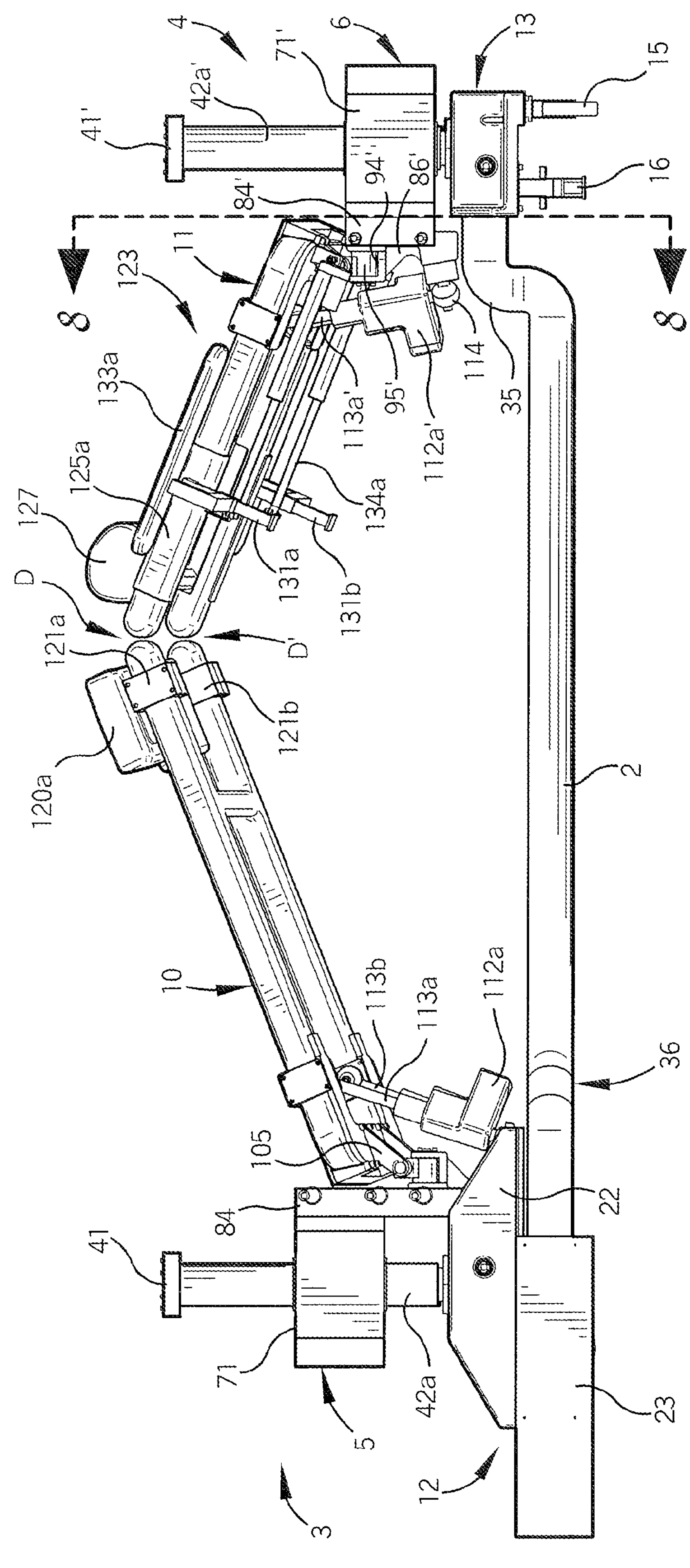

4
6
13
15
16
71'
42a'
41'
94'
86'
84'
123
11
8
8
133a
113a'
95'
112a'
114
35
125a
127
134a
131a
131b
1
D
D'
121a
121b
120a
2
10
113b
113a
112a
36
105
22
84
41
71
42a
23
5
12
3

Fig. 7

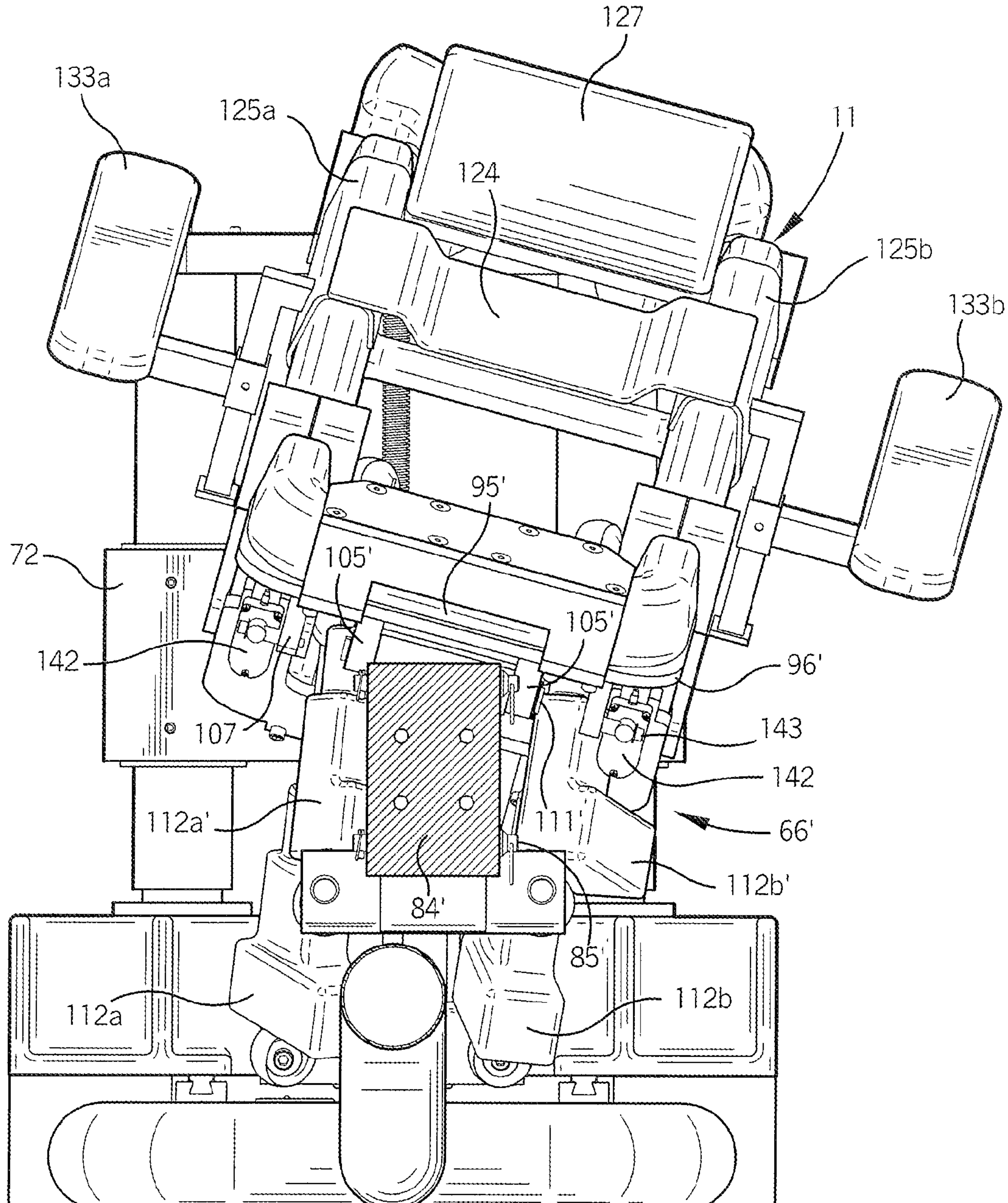

127
133a
125a
11
124
125b
133b
95'
72
105'
105'
142
96'
107
143
142
112a'
111'
66'
112b'
84'
85'
112a
112b

Fig. 8

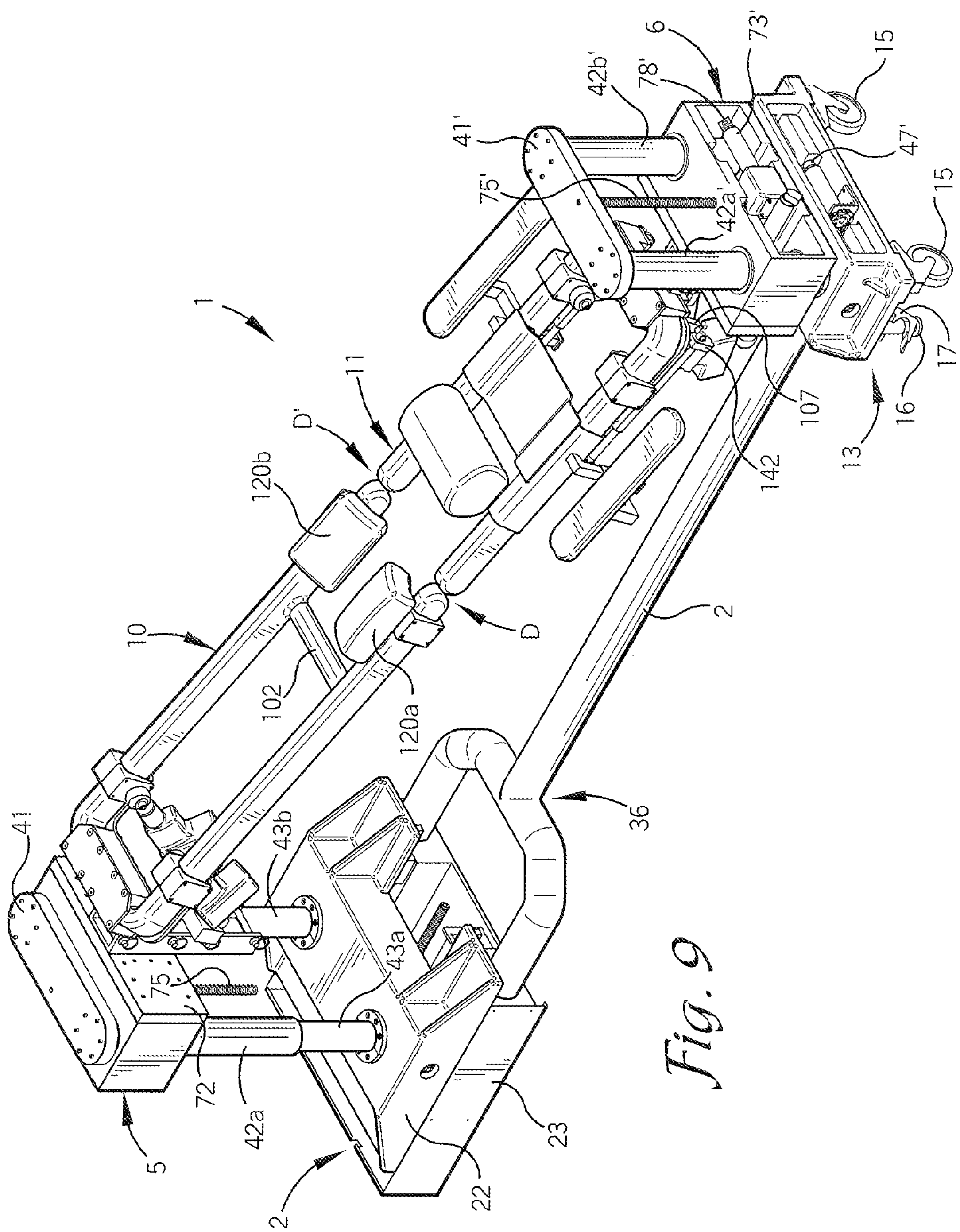

1
2
5
6
10
11
12
13
15
15
16
17
22
23
36
41
41'
42a
42a'
42b'
43a
43b
47'
72
73'
75
75'
78'
102
107
120a
120b
142
D
D'

Fig. 9

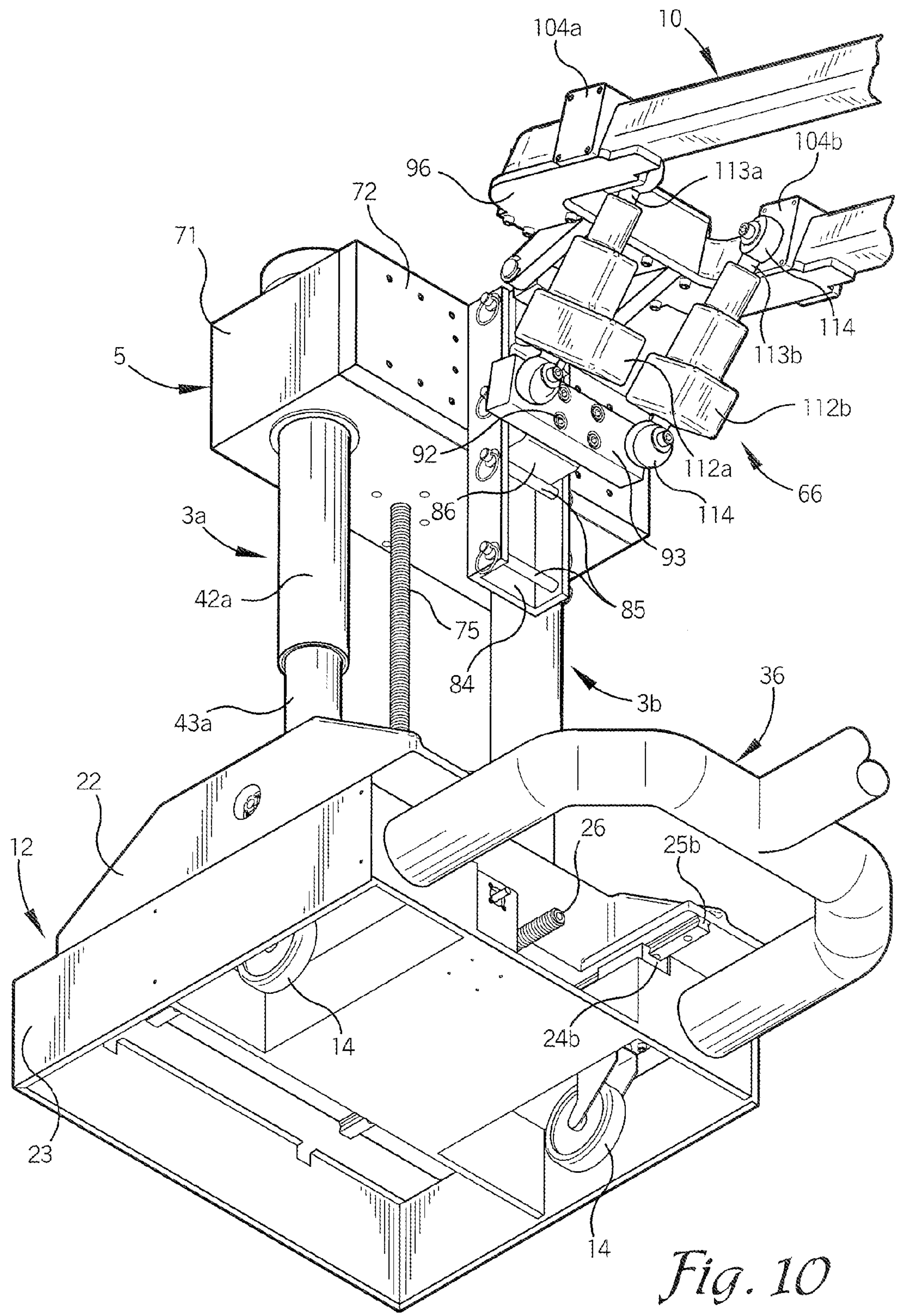

10
104a
104b
96
113a
72
71
5
114
113b
112b
92
112a
86
114
66
3a
93
42a
85
75
84
3b
36
43a
22
26
25b
12
14
24b
23
14

Fig. 10

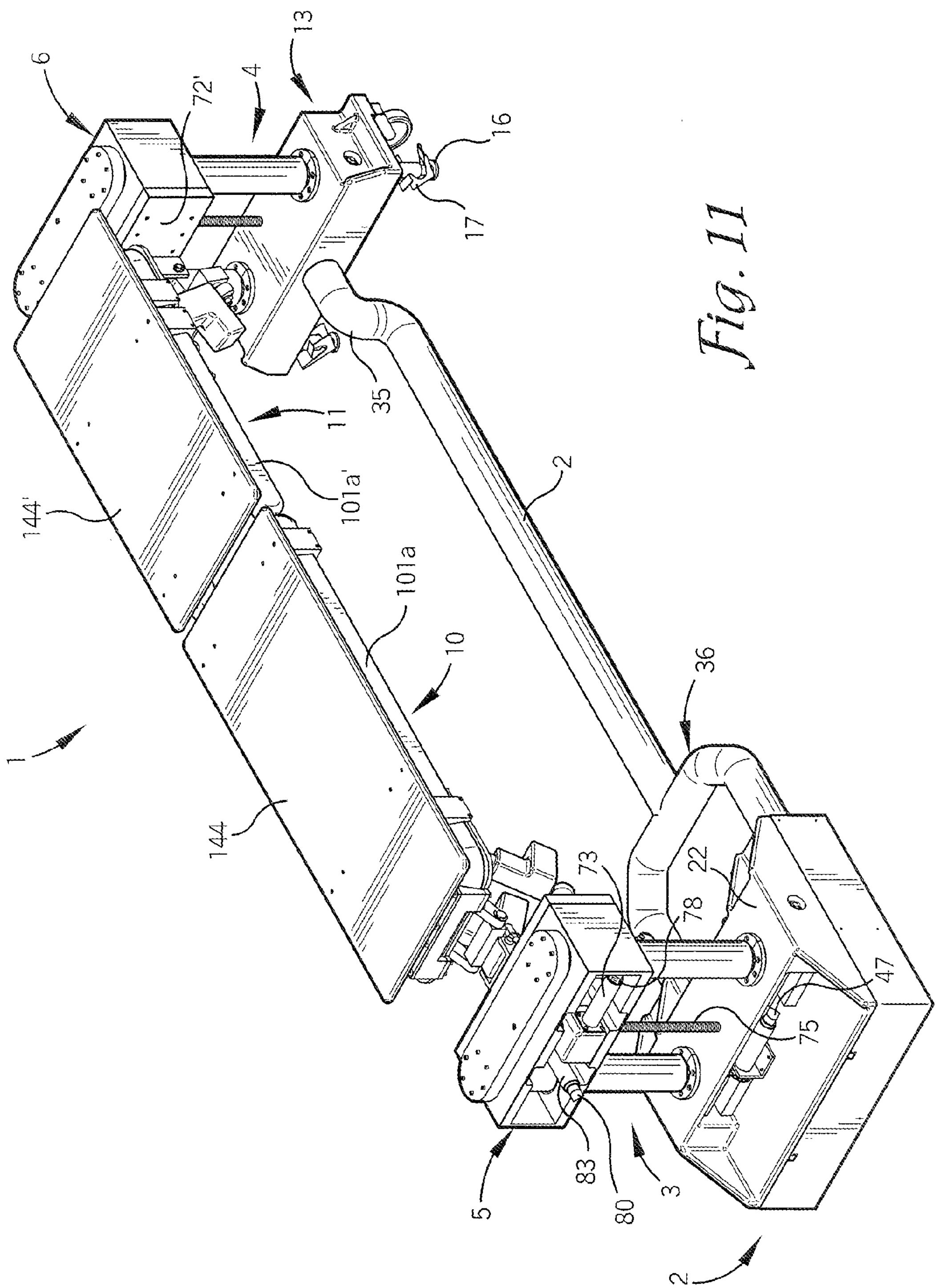

1
2
3
4
5
6
10
11
12
13
16
17
22
35
36
47
72'
73
75
78
80
83
101a
101a'
144
144'

Fig. 11

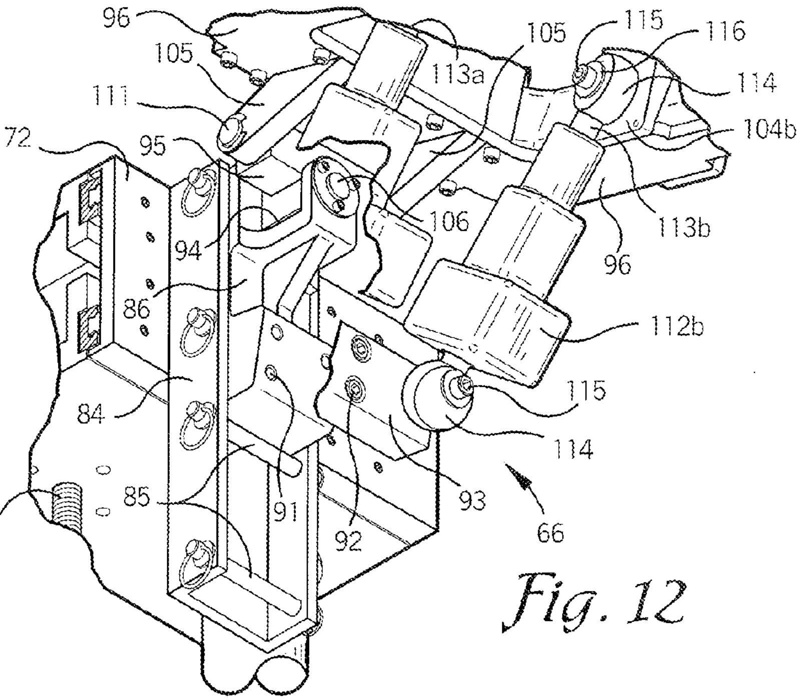

96
105
111
72
95
94
86
84
85
75
113a
105
115
116
114
104b
106
113b
96
112b
115
114
93
91
92
66

Fig. 12

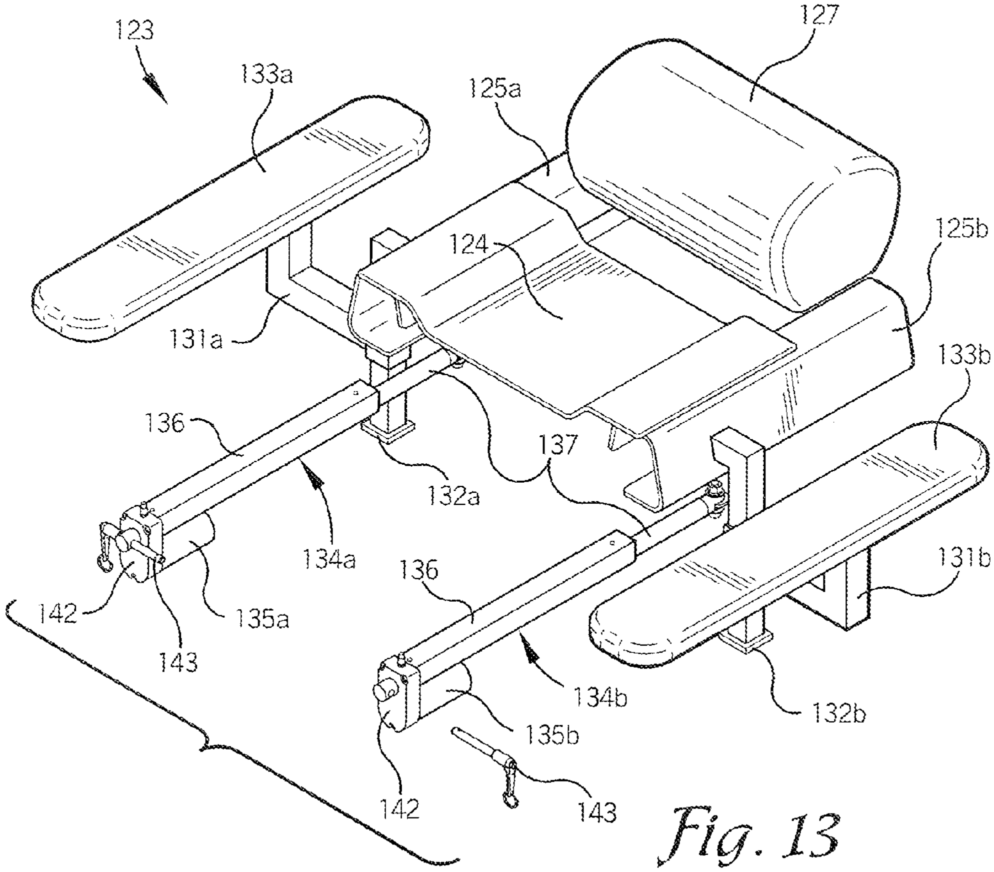

123
133a
125a
127
124
125b
131a
133b
136
137
132a
134a
131b
136
142
143
135a
134b
132b
135b
142
143

Fig. 13

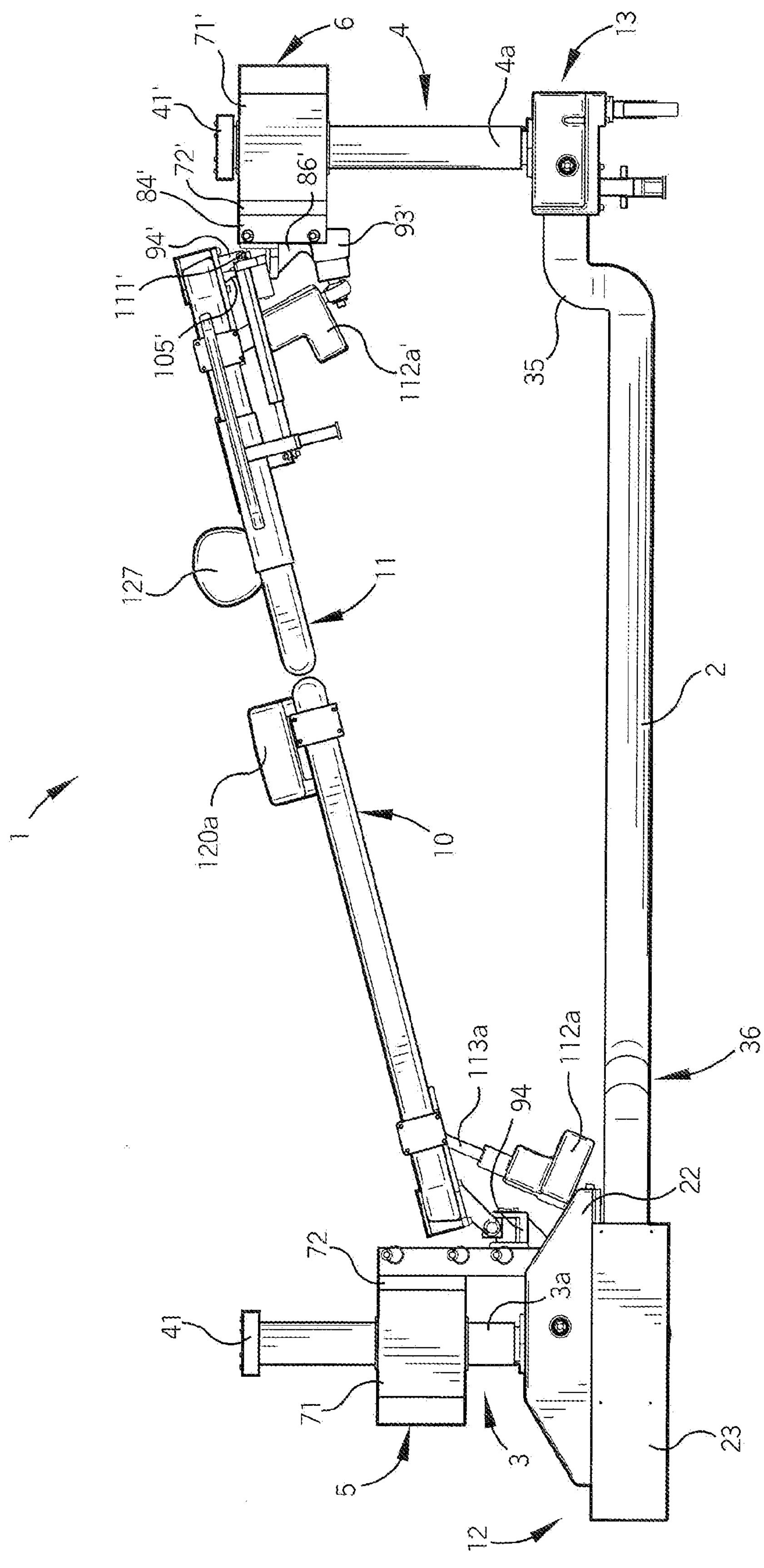
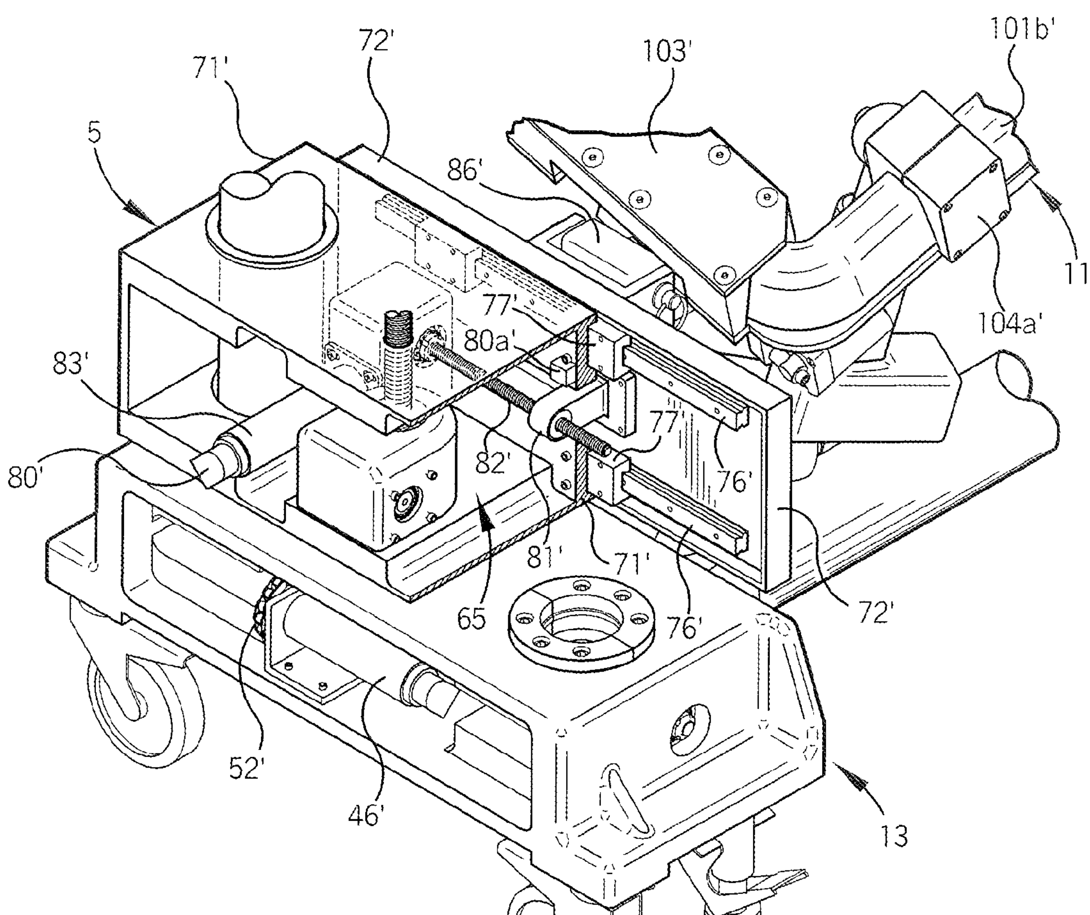

1
2
3
3a
4
4a
5
6
10
11
12
13
22
23
35
36
41
41'
71
71'
72
72'
84'
86'
93'
94
94'
105'
111'
112a
112a'
113a
120a
127

Fig. 14



5
71'
72'
103'
101b'
86'
11
104a'
77'
80a'
83'
82'
77'
76'
80'
81'
71'
65
76'
72'
52'
46'
13

Fig. 15

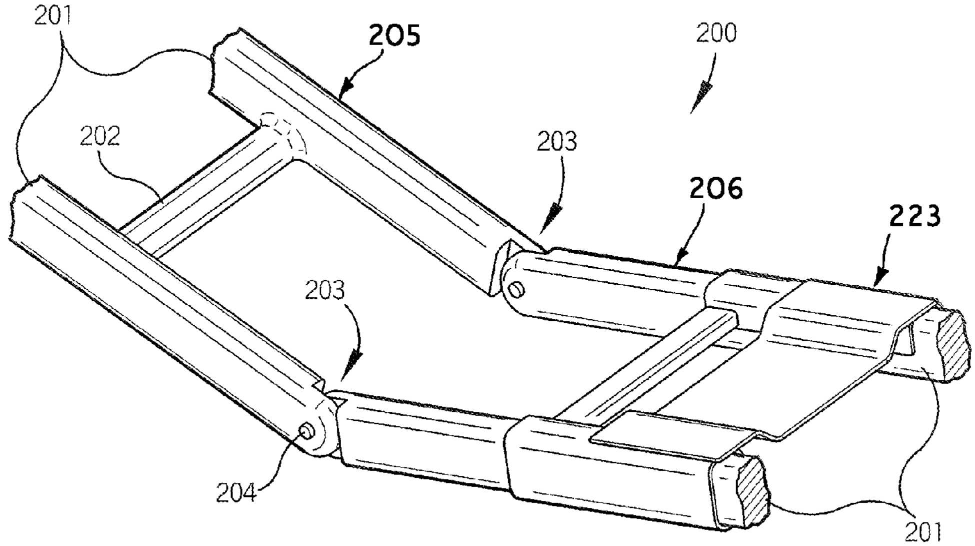

201
205
200
202
203
206
223
203
204
201

Fig. 16

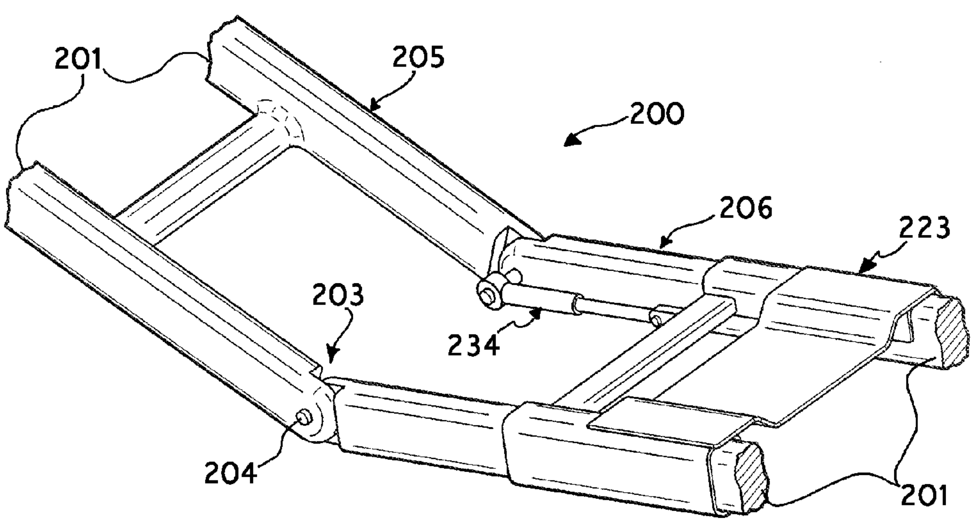

201
205
200
206
223
203
234
204
201

Fig. 17

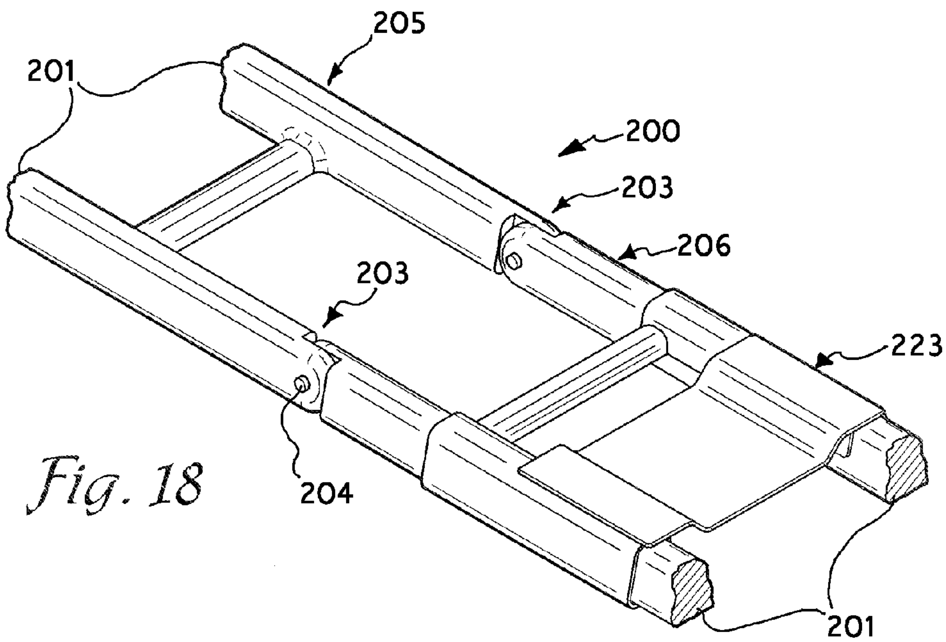

205
201
200
203
206
203
223
204
201

Fig. 18

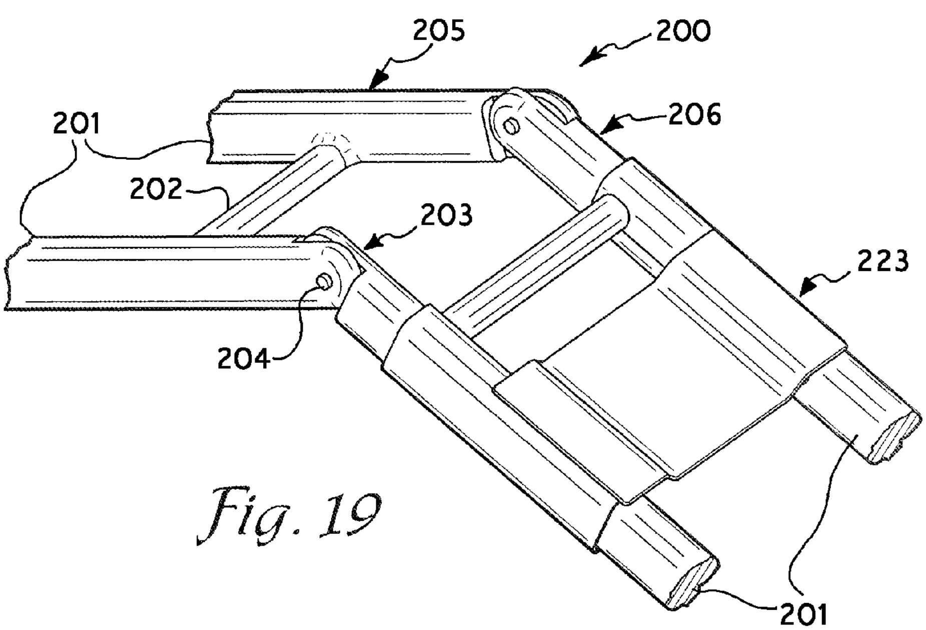

205
200
201
206
202
203
223
204
201

Fig. 19

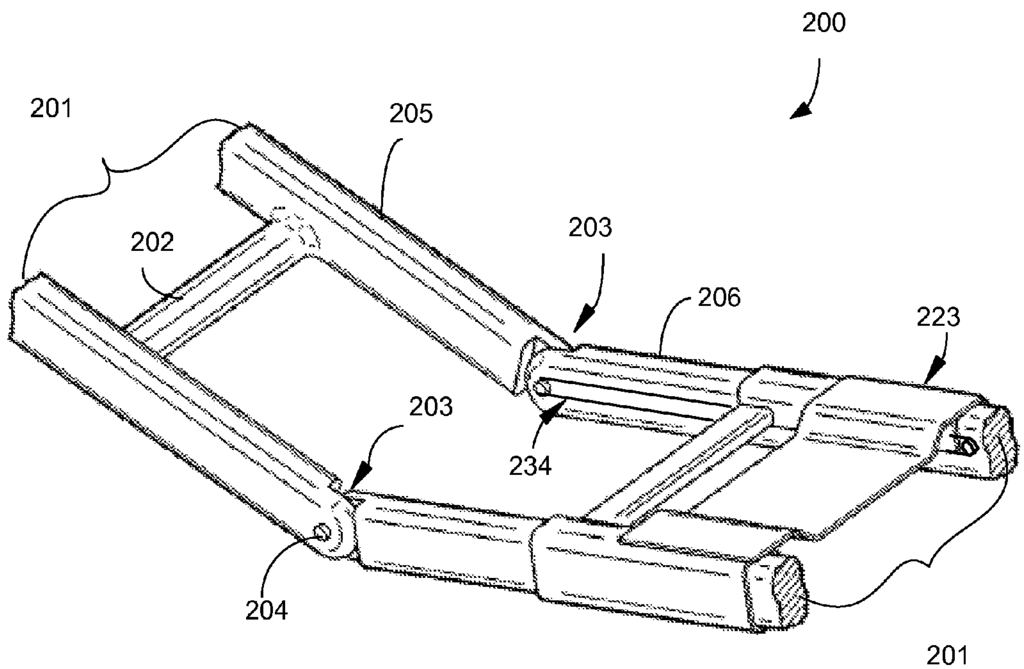


Fig. 20

PATIENT POSITIONING SUPPORT STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. application Ser. No. 12/803,173 filed Jun. 21, 2010 and now U.S. Pat. No. 8,707,484, which was a continuation-in-part of U.S. application Ser. No. 12/460,702 filed Jul. 23, 2009 and now U.S. Pat. No. 8,060,960, which was a continuation of U.S. application Ser. No. 11/788,513 filed Apr. 20, 2007, now U.S. Pat. No. 7,565,708, which claimed the benefit of U.S. Provisional Application No. 60/798,288 filed May 5, 2006 and which was also a continuation-in-part of U.S. application Ser. No. 11/159,494 filed Jun. 23, 2005, now U.S. Pat. No. 7,343,635, which was a continuation-in-part of U.S. application Ser. No. 11/062,775 filed Feb. 22, 2005, now U.S. Pat. No. 7,152,261. The entire contents of all of the foregoing applications and patents are fully incorporated herein by reference.

BACKGROUND OF THE INVENTION

The present disclosure is broadly concerned with structure for use in supporting and maintaining a patient in a desired position during examination and treatment, including medical procedures such as imaging, surgery and the like. More particularly, it is concerned with structure having patient support modules that can be independently adjusted to allow a surgeon to selectively position the patient for convenient access to the surgical field and provide for manipulation of the patient during surgery including the tilting, lateral shifting, pivoting, angulation or bending of a trunk and/or a joint of a patient while in a generally supine, prone or lateral position. It is also concerned with structure for adjusting and/or maintaining the spatial relation between the inboard ends of the patient supports and for synchronized translation of the upper body of a patient as the inboard ends of the two patient supports are angled upwardly and downwardly.

Current surgical practice incorporates imaging techniques and technologies throughout the course of patient examination, diagnosis and treatment. For example, minimally invasive surgical techniques, such as percutaneous insertion of spinal implants involve small incisions that are guided by continuous or repeated intra-operative imaging. These images can be processed using computer software programs that product three dimensional images for reference by the surgeon during the course of the procedure. If the patient support surface is not radiolucent or compatible with the imaging technologies, it may be necessary to interrupt the surgery periodically in order to remove the patient to a separate surface for imaging, followed by transfer back to the operating support surface for resumption of the surgical procedure. Such patient transfers for imaging purposes may be avoided by employing radiolucent and other imaging compatible systems. The patient support system should also be constructed to permit unobstructed movement of the imaging equipment and other surgical equipment around, over and under the patient throughout the course of the surgical procedure without contamination of the sterile field.

It is also necessary that the patient support system be constructed to provide optimum access to the surgical field by the surgery team. Some procedures require positioning of portions of the patient's body in different ways at different times during the procedure. Some procedures, for example, spinal surgery, involve access through more than one surgical site or field. Since all of these fields may not be in the same plane or

anatomical location, the patient support surfaces should be adjustable and capable of providing support in different planes for different parts of the patient's body as well as different positions or alignments for a given part of the body. Preferably, the support surface should be adjustable to provide support in separate planes and in different alignments for the head and upper trunk portion of the patient's body, the lower trunk and pelvic portion of the body as well as each of the limbs independently.

Certain types of surgery, such as orthopedic surgery, may require that the patient or a part of the patient be repositioned during the procedure while in some cases maintaining the sterile field. Where surgery is directed toward motion preservation procedures, such as by installation of artificial joints, spinal ligaments and total disc prostheses, for example, the surgeon must be able to manipulate certain joints while supporting selected portions of the patient's body during surgery in order to facilitate the procedure. It is also desirable to be able to test the range of motion of the surgically repaired or stabilized joint and to observe the gliding movement of the reconstructed articulating prosthetic surfaces or the tension and flexibility of artificial ligaments, spacers and other types of dynamic stabilizers before the wound is closed. Such manipulation can be used, for example, to verify the correct positioning and function of an implanted prosthetic disc, spinal dynamic longitudinal connecting member, interspinous spacer or joint replacement during a surgical procedure. Where manipulation discloses binding, sub-optimal position or even crushing of the adjacent vertebrae, for example, as may occur with osteoporosis, the prosthesis can be removed and the adjacent vertebrae fused while the patient remains anesthetized. Injury which might otherwise have resulted from a "trial" use of the implant post-operatively will be avoided, along with the need for a second round of anesthesia and surgery to remove the implant or prosthesis and perform the revision, fusion or corrective surgery.

There is also a need for a patient support surface that can be articulated and angulated so that the patient can be moved from a prone to an upwardly angled position or from a supine to a downwardly angled position and whereby intra-operative extension and flexion of at least a portion of the spinal column can be achieved. The patient support surface must also be capable of easy, selective adjustment without necessitating removal of the patient or causing substantial interruption of the procedure.

For certain types of surgical procedures, for example spinal surgeries, it may be desirable to position the patient for sequential anterior and posterior procedures. The patient support surface should also be capable or rotation about an axis in order to provide correct positioning of the patient and optimum accessibility for the surgeon as well as imaging equipment during such sequential procedures.

Orthopedic procedures may also require the use of traction equipment such a cables, tongs, pulleys and weights. The patient support system must include structure for anchoring such equipment and it must provide adequate support to withstand unequal forces generated by traction against such equipment.

Articulated robotic arms are increasingly employed to perform surgical techniques. These units are generally designed to move short distances and to perform very precise work. Reliance on the patient support structure to perform any necessary gross movement of the patient can be beneficial, especially if the movements are synchronized or coordinated. Such units require a surgical support surface capable of smoothly performing the multi-directional movements which would otherwise be performed by trained medical personnel.

There is thus a need in this application as well for integration between the robotics technology and the patient positioning technology.

While conventional operating tables generally include structure that permits tilting or rotation of a patient support surface about a longitudinal axis, previous surgical support devices have attempted to address the need for access by providing a cantilevered patient support surface on one end. Such designs typically employ either a massive base to counterbalance the extended support member or a large overhead frame structure to provide support from above. The enlarged base members associated with such cantilever designs are problematic in that they can and do obstruct the movement of C-arm and O-arm mobile fluoroscopic imaging devices and other equipment. Surgical tables with overhead frame structures are bulky and may require the use of dedicated operating rooms, since in some cases they cannot be moved easily out of the way. Neither of these designs is easily portable or storable.

Articulated operating tables that employ cantilevered support surfaces capable of upward and downward angulation require structure to compensate for variations in the spatial relation of the inboard ends of the supports as they are raised and lowered to an angled position either above or below a horizontal plane. As the inboard ends of the supports are raised or lowered, they form a triangle, with the horizontal plane of the table forming the base of the triangle. Unless the base is commensurately shortened or the frame or patient support structure is elongated, a gap will develop between the inboard ends of the supports.

Such up and down angulation of the patient supports also causes a corresponding flexion or extension, respectively, of the lumbar spine of a prone patient positioned on the supports. Raising the inboard ends of the patient supports generally causes flexion of the lumbar spine of a prone patient with decreased lordosis and a coupled or corresponding posterior rotation of the pelvis around the hips. When the top of the pelvis rotates in a posterior direction, it pulls the lumbar spine and wants to move or translate the thoracic spine in a caudad direction, toward the patient's feet. If the patient's trunk, entire upper body and head and neck are not free to translate or move along the support surface in a corresponding caudad direction along with the posterior pelvic rotation, excessive traction along the entire spine can occur, but especially in the lumbar region. Conversely, lowering the inboard ends of the patient supports with downward angulation causes extension of the lumbar spine of a prone patient with increased lordosis and coupled anterior pelvic rotation around the hips. When the top of the pelvis rotates in an anterior direction, it pushes and wants to translate the thoracic spine in a cephalad direction, toward the patient's head. If the patient's trunk and upper body are not free to translate or move along the longitudinal axis of the support surface in a corresponding cephalad direction during lumbar extension with anterior pelvic rotation, unwanted compression of the spine can result, especially in the lumbar region.

Thus, there remains a need for a patient support system that provides easy access for personnel and equipment, that can be positioned and repositioned easily and quickly in multiple planes without the use of massive counterbalancing support structure, and that does not require use of a dedicated operating room. There is also a need for such a system that permits upward and downward angulation of the inboard ends of the supports, either alone or in combination with rotation or roll about the longitudinal axis, all while maintaining the ends in a preselected spatial relation, and at the same time providing for coordinated translation of the patient's upper body in a corresponding caudad or cephalad direction to thereby avoid excessive compression or traction on the spine.

SUMMARY OF THE INVENTION

The present disclosure is directed to a patient positioning support structure that permits adjustable positioning, repositioning and selectively lockable support of a patient's head and upper body, lower body and limbs in up to a plurality of individual planes while permitting rolling or tilting, lateral shifting, angulation or bending and other manipulations as well as full and free access to the patient by medical personnel and equipment. The system of the invention includes at least one support end or column that is height adjustable. The illustrated embodiments include a pair of opposed, independently height-adjustable end support columns. The columns may be independent or connected to a base. Longitudinal translation structure is provided enabling adjustment of the distance or separation between the support columns. One support column may be coupled with a wall mount or other stationary support. The support columns are each connected with a respective patient support, and structure is provided for raising, lowering, roll or tilt about a longitudinal axis, lateral shifting and angulation of the respective connected patient support, as well as longitudinal translation structure for adjusting and/or maintaining the distance or separation between the inboard ends of the patient supports during such movements.

The patient supports may each be an open frame or other patient support that may be equipped with support pads, slings or trolleys for holding the patient, or other structures, such as imaging or other tops which provide generally flat surfaces. Each patient support is connected to a respective support column by a respective roll or tilt, articulation or angulation adjustment mechanism for positioning the patient support with respect to its end support as well as with respect to the other patient support. Roll or tilt adjustment mechanisms in cooperation with pivoting and height adjustment mechanisms provide for the lockable positioning of the patient supports in a variety of selected positions and with respect to the support columns, including coordinated rolling or tilting, upward and downward coordinated angulation (Trendelenburg and reverse Trendelenburg configurations), upward and downward breaking angulation, and lateral shifting toward and away from a surgeon.

At least one of the support columns includes structure enabling movement of the support column toward or away from the other support column in order to adjust and/or maintain the distance between the support columns as the patient supports are moved. Lateral movement of the patient supports (toward and away from the surgeon) is provided by a bearing block feature. A trunk translator for supporting a patient on one of the patient supports cooperates with all of the foregoing, in particular the upward and downward breaking angulation adjustment structure, to provide for synchronized translational movement of the upper portion of a patient's body along the length of one of the patient supports in a respective corresponding caudad or cephalad direction for maintaining proper spinal biomechanics and avoiding undue spinal traction or compression.

Sensors can be provided to measure all of the vertical, horizontal or lateral shift, angulation, tilt or roll movements and longitudinal translation of the patient support system. The sensors can be electronically connected with and transmit data to a computer that calculates and adjusts the movements of the patient trunk translator and the longitudinal translation structure to provide coordinated patient support with proper biomechanics.

Various objects and advantages of this patient support structure will become apparent from the following description taken in conjunction with the accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this disclosure.

The drawings constitute a part of this specification, include exemplary embodiments, and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevational view of an embodiment of a patient positioning support structure according to the invention.

FIG. **2** is a perspective view of the structure of FIG. **1** with the trunk translation assembly shown in phantom in a removed position.

FIG. **3** is an enlarged fragmentary perspective view of one of the support columns with patient support structure of FIG. **1**.

FIG. **4** is an enlarged fragmentary perspective view of the other support column of the patient positioning support structure of FIG. **1**, with parts broken away to show details of the base structure.

FIG. **5** is a transverse sectional view taken along line **5-5** of FIG. **1**.

FIG. **6** is a perspective sectional view taken along line **6-6** of FIG. **1**.

FIG. **7** is a side elevational view of the structure of FIG. **1** shown in a laterally tilted position with the patient supports in an upward breaking position, and with both ends in a lowered position.

FIG. **8** is an enlarged transverse sectional view taken along line **8-8** of FIG. **7**.

FIG. **9** is a perspective view of the structure of FIG. **1** with the patient supports shown in a planar inclined position, suitable for positioning a patient in Trendelenburg's position.

FIG. **10** is an enlarged partial perspective view of a portion of the structure of FIG. **1**.

FIG. **11** is a perspective view of the structure of FIG. **1** shown with a pair of planar patient support surfaces replacing the patient supports of FIG. **1**.

FIG. **12** is an enlarged perspective view of a portion of the structure of FIG. **10**, with parts broken away to show details of the angulation/rotation subassembly.

FIG. **13** is an enlarged perspective view of the trunk translator shown disengaged from the structure of FIG. **1**.

FIG. **14** is a side elevational view of the structure of FIG. **1** shown in an alternate planar inclined position.

FIG. **15** is an enlarged perspective view of structure of the second end support column, with parts broken away to show details of the horizontal shift subassembly.

FIG. **16** is an enlarged fragmentary perspective view of an alternate patient positioning support structure incorporating a mechanical articulation of the inboard ends of the patient supports and showing the patient supports in a downward angled position and the trunk translator moved away from the hinge.

FIG. **17** is a view similar to FIG. **16**, showing a linear actuator engaged with the trunk translator to coordinate positioning of the translator with pivoting about the hinge.

FIG. **18** is a view similar to FIGS. **17** and **18**, showing the patient supports in a horizontal position.

FIG. **19** is a view similar to FIG. **17**, showing the patient supports in an upward angled position and the trunk translator moved toward the hinge.

FIG. **20** is a view similar to FIG. **16**, showing a cable engaged with the trunk translator to coordinate positioning of the translator with pivoting about the hinge.

DETAILED DESCRIPTION

As required, detailed embodiments of the patient positioning support structure are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the apparatus, which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the disclosure in virtually any appropriately detailed structure.

Referring now to the drawings, an embodiment of a patient positioning support structure according to the disclosure is generally designated by the reference numeral **1** and is depicted in FIGS. **1-12**. The structure **1** includes first and second upright end support pier or column assemblies **3** and **4** which are illustrated as connected to one another at their bases by an elongate connector rail or rail assembly **2**. It is foreseen that the column support assemblies **3** and **4** may be constructed as independent, floor base supports that are not interconnected as shown in the illustrated embodiment. It is also foreseen that in certain embodiments, one or both of the end support assemblies may be replaced by a wall mount or other building support structure connection, or that one or both of their bases may be fixedly connected to the floor structure. The first upright support column assembly **3** is connected to a first support assembly, generally **5**, and the second upright support column assembly **4** is connected to a second support assembly **6**. The first and second support assemblies **5** and **6** each uphold a respective first or second patient holding or support structure **10** or **11**. While cantilevered type patient supports **10** and **11** are depicted, it is foreseen that they could be connected by a permanent or removable hinge member.

The column assemblies **3** and **4** are supported by respective first and second base members, generally **12** and **13**, each of which are depicted as equipped with an optional carriage assembly including a pair of spaced apart casters or wheels, **14** and **15** (FIGS. **9** and **10**). The second base portion **13** further includes a set of optional feet **16** with foot-engageable jacks **17** (FIG. **11**) for fixing the table **1** to the floor and preventing movement of the wheels **15**. It is foreseen that the support column assemblies **3** and **4** may be constructed so that the column assembly **3** has a greater mass than the support column assembly **4** or vice versa in order to accommodate an uneven weight distribution of the human body. Such reduction in size at the foot end of the system **1** may be employed in some embodiments to facilitate the approach of personnel and equipment.

The first base member **12**, best shown in FIGS. **4** and **7**, is normally located at the bottom or foot end of the structure **1** and houses, and is connected to, a longitudinal translation or compensation subassembly **20**, including a bearing block or support plate **21** surmounted by a slidable upper housing **22**. Removable shrouding **23** spans the openings at the sides and rear of the bearing block **21** to cover the working parts beneath. The shrouding **23** prevents encroachment of feet, dust or small items that might impair sliding back and forth movement of the upper housing on the bearing block **21**.

A pair of spaced apart linear bearings **24**a and **24**b (FIG. **5**) are mounted on the bearing block **21** for orientation along the longitudinal axis of the structure **1**. The linear bearings **24**a and **24**b slidably receive a corresponding pair of linear rails or guides **25**a and **25**b that are mounted on the downward-facing surface of the upper housing **22**. The upper housing **22** slides back and forth over the bearing block **21** when powered by a lead screw or power screw **26** (FIG. **4**) that is driven by a motor **31** by way of gearing, a chain and sprockets, or the like (not shown). The motor **31** is mounted on the bearing block **21** by fasteners such as bolts or other suitable means and is held in place by an upstanding motor cover plate **32**. The lead screw **26** is threaded through a nut **33** mounted on a nut carrier **34**, which is fastened to the downward-facing surface of the upper housing **22**. The motor **31** includes a position sensing device or sensor **27** that is electronically connected with sensor circuitry or a computer **28**. The sensor **27** determines the longitudinal position of the upper housing **22** and converts it to a code, which it transmits to the computer **28**. The sensor **27** is preferably a rotary encoder with a home or limit switch **27**a (FIG. **5**) that may be activated by the linear rails **25**a, **25**b or any other moving part of the translation compensation subassembly **20**. The rotary sensor **27** may be a mechanical, optical, binary encoding, or Gray encoding sensor device, or it may be of any other suitable construction capable of sensing horizontal movement by deriving incremental counts from a rotating shaft, and encoding and transmitting the information to the computer **28**. The home switch **27**a provides a zero or home reference position for measurement.

The longitudinal translation subassembly **20** is operated by actuating the motor **31** to drive the lead screw **26** such as, for example, an Acme thread form, which causes the nut **33** and attached nut carrier **34** to advance along the screw **26**, thereby advancing the linear rails **25**a and **25**b, along the respective linear bearings **24**a and **24**b, and moving the attached upper housing **22** along a longitudinal axis, toward or away from the opposite end of the structure **1** as shown in FIG. **10**. The motor **31** may be selectively actuated by an operator by use of a control (not shown) on a controller or control panel **29**, or it may be actuated by responsive control instructions transmitted by the computer **28** in accordance with preselected parameters which are compared to data received from sensors detecting movement in various parts of the structure **1**, including movement that actuates the home switch **27**a.

This construction enables the distance between the support column assemblies **3** and **4** (essentially the overall length of the table structure **1**) to be shortened from the position shown in FIGS. **1** and **2** in order to maintain the distances D and D' between the inboard ends of the patient supports **10** and **11** when they are positioned, for example, in a planar inclined position as shown in FIG. **9** or in an upwardly (or downwardly) angled or breaking position as shown in FIG. **7** and/or a partially rotated or tilted position also shown in FIG. **7**. It also enables the distance between the support column assemblies **3** and **4** to be extended and returned to the original position when the patient supports **10** and **11** are repositioned in a horizontal plane as shown in FIG. **1**. Because the upper housing **22** is elevated and slides forwardly and rearwardly over the bearing block **21**, it will not run into the feet of the surgical team when the patient supports **10** and **11** are raised and lowered. A second longitudinal translation subassembly **20** may be connected to the second base member **13** to permit movement of both bases **12** and **13** in compensation for angulation of the patient supports **10** and **11**. It is also foreseen that the translation assembly may alternatively connected to one or more of the housings **71** and **71'** (FIG. **2**) of the first and second support assemblies **5** and **6**, for positioning closer to the patient support surfaces **10** and **11**. It is also foreseen that the rail assembly **2** could be configured as a telescoping mechanism with the longitudinal translation subassembly **20** incorporated therein.

The second base member **13**, shown at the head end of the structure **1**, includes a housing **37** (FIG. **2**) that surmounts the wheels **15** and feet **16**. Thus, the top of the housing **37** is generally in a plane with the top of the upper housing **22** of the first base member **12**. The connector rail **2** includes a vertically oriented elbow **35** to enable the rail **2** to provide a generally horizontal connection between the first and second bases **12** and **13**. The connector rail **2** has a generally Y-shaped overall configuration, with the bifurcated Y or yoke portion **36** adjacent the first base member **12** (FIGS. **2**, **7**) for receiving portions of the first horizontal support assembly **5** when they are in a lowered position and the upper housing **22** is advanced forwardly, over the rail **2**. It is foreseen that the orientation of the first and second base members **12** and **13** may be reversed so that the first base member **12** is located at the head end of the patient support structure **1** and the second base member **13** is located at the foot end.

The first and second base members **12** and **13** are surmounted by respective first and second upright end support or column lift assemblies **3** and **4**. The column lift assemblies each include a pair of laterally spaced columns **3**a and **3**b or **4**a and **4**b (FIGS. **2**, **9**), each pair surmounted by an end cap **41** or **41'**. The columns each include two or more telescoping lift arm segments, an outer segment **42**a and **42**b and **42**a' and **42**b' and an inner segment **43**a and **43**b and **43**a' and **43**b' (FIGS. **5** and **6**). Bearings **44**a, **44**b and **44**a' and **44**b' enable sliding movement of the outer portion **42** or **42'** over the respective inner portion **43** or **43'** when actuated by a lead or power screw **45**a, **45**b, **45**a', or **45**b' driven by a respective motor **46** (FIG. **4**) or **46'** (FIG. **6**). In this manner, the column assemblies **3** and **4** are raised and lowered by the respective motors **46** and **46'**.

The motors **46** and **46'** each include a position sensing device or sensor **47**, **47'** (FIGS. **9** and **11**) that determines the vertical position or height of the lift arm segments **42**a,b and **42**a',b' and **44**a,b and **44**a'b' and converts it to a code, which it transmits to a computer **28**. The sensors **47**, **47'** are preferably rotary encoders with home switches **47**a, **47**a' (FIGS. **5** and **6**), as previously described.

As best shown in FIG. **4**, the motor **46** is mounted to a generally L-shaped bracket **51**, which is fastened to the upward-facing surface of the bottom portion of the upper housing **22** by fasteners such as bolts or the like. As shown in FIG. **6**, the motor **46'** is similarly fastened to a bracket **51'**, which is fastened to the inner surface of the bottom portion of the second base housing **13**. Operation of the motors **46** and **46'** drives respective sprockets **52** (FIG. **5**) and **52'** (FIG. **6**). Chains **53** and **53'** (FIGS. **4** and **6**) are reeved about their respective driven sprockets as well as about respective idler sprockets **54** (FIG. **4**) which drive shafts **55** when the motors **46** and **46'** are operated. The shafts **55** each drive a worm gear **56**a, **55**b and **56**a', **56**b' (FIGS. **5**, **6**), which is connected to a lead screw **45**a and **45**b or **45**a' and **45**b'. Nuts **61**a, **61**b and **61**a', **61**b' attach the lead screws **45**a, **45**b and **45**a', **45**b' to bolts **62**a, **62**b and **62**a', **62**b', which are fastened to rod end caps **63**a, **63**b and **63**a', **63**b', which are connected to the inner lift arm segments **43**a, **43**b and **43**a', **43**b'. In this manner, operation of the motors **46** and **46'** drives the lead screws **45**a, **45**b and **45**a', **45**b', which raise and lower the inner lift arm segments **43**a, **43**b and **43**a', **43**b' (FIGS. **1**, **10**) with respect to the outer lift arm segments **42**a, **42**b, and **42**a', **42**b'.

Each of the first and second support assemblies **5** and **6** (FIG. **1**) generally includes a secondary vertical lift subassembly **64** and **64'** (FIGS. **2** and **6**), a lateral or horizontal shift subassembly **65** and **65'** (FIGS. **5** and **15**), and an angulation/tilt or roll subassembly **66** and **66'** (FIGS. **8**, **10** and **12**). The second support assembly **6** also including a patient trunk translation assembly or trunk translator **123** (FIGS. **2**, **3**, **13**), which are interconnected as described in greater detail below and include associated power source and circuitry linked to a computer **28** and controller **29** (FIG. **1**) for coordinated and integrated actuation and operation.

The column lift assemblies **3**, **4** and secondary vertical lift subassemblies **64** and **64'** in cooperation with the angulation and roll or tilt subassemblies **66** and **66'** cooperatively enable the selective breaking of the patient supports **10** and **11** at desired height levels and increments as well as selective angulation of the supports **10** and **11** in combination with coordinated roll or tilt of the patient supports **10** and **11** about a longitudinal axis of the structure **1**. The lateral or horizontal shift subassemblies **65** and **65'** enable selected, coordinated horizontal shifting of the patient supports **10** and **11** along an axis perpendicular to the longitudinal axis of the structure **1**, either before or during performance of any of the foregoing maneuvers (FIG. **15**). In coordination with the column lift assemblies **3** and **4** and the secondary vertical lift subassemblies **64** and **64'**, the angulation and roll or tilt subassemblies **66** and **66'** enable coordinated selective raising and lowering of the patient supports **10** and **11** to achieve selectively raised and lowered planar horizontal positions (FIGS. **1**, **2** and **11**), planar inclined positions such as Trendelenburg's position and the reverse (FIGS. **9**, **14**), angulation of the patient support surfaces in upward (FIG. **7**) and downward breaking angles with sideways roll or tilting of the patient support structure **1** about a longitudinal axis of the structure **1** (FIG. **8**), all at desired height levels and increments.

During all of the foregoing operations, the longitudinal translation subassembly **20** enables coordinated adjustment of the position of the first base member so as to maintain the distances D and D' between the inboard ends of the patient supports **10** and **11** as the base of the triangle formed by the supports is lengthened or shortened in accordance with the increase or decrease of the angle subtended by the inboard ends of the supports **10** and **11** (FIGS. **7**, **9**, **10** and **14**).

The trunk translation assembly **123** (FIGS. **2**, **3**, **13**) enables coordinated shifting of the patient's upper body along the longitudinal axis of the patient support **11** as required for maintenance of normal spinal biomechanics and avoidance of excessive traction or compression of the spine as the angle subtended by the inboard ends of the supports **10** and **11** is increased or decreased.

The first and second horizontal support assemblies **5** and **6** (FIG. **2**) each include a housing **71** and **71'** having an overall generally hollow rectangular configuration, with inner structure forming a pair of vertically oriented channels that receive the outer lift arm segments **42**A, **42**B and **42***a'*, **42***b'* (FIGS. **5**, **6**). The inboard face of each housing **71** and **71'** is covered by a carrier plate **72**, **72'** (FIG. **2**). The secondary vertical lift subassemblies **64** and **64'** (FIGS. **2**, **5** and **6**) each include a motor **73** and **73'** that drives a worm gear (not shown) housed in a gear box **74** or **74'** connected to the upper bottom surface of the housing **71** or **71'**. The worm gear drivingly engages a lead or power screw **75** and **75'**, the uppermost end of which is connected to the lower surface or bottom of the respective end cap **41** and **41'**.

The motors **73** and **73'** each include a respective position sensing device or height sensor **78**, **78'** (FIGS. **9** and **11**) that determines the vertical position of the respective housing **70** and **71** and converts it to a code, which it transmits to the computer **28**. The sensors **78** and **78'** are preferably rotary encoders as previously described and cooperate with respective home switches **78***a* and **78***a'* (FIGS. **5** and **6**). An example of an alternate height sensing device is described in U.S. Pat. No. 4,777,798, the disclosure of which patent is incorporated by reference. As the motor **73** or **73'** rotates the worm gear, it drives the lead screw **75** or **75'**, thereby causing the housing **71** or **71'** to shift upwardly or downwardly over the outer lift arm segments **42** and **42"**. Selective actuation of the motors **73** and **73'** thus enables the respective housings **71** and **71'** to ride up and down on the columns **3***a* and **3***b* and **4***a* and **4***b* between the end caps **41** and **41'** and base members **12** and **13** (FIGS. **7**, **9** and **14**). Coordinated actuation of the column motors **46** and **46'** with the secondary vertical lift motors **73** and **73'** enables the housings **71** and **71'** and their respective attached carrier plates **72** and **72'**, and thus the patient supports **10** and **11**, to be raised to a maximum height, or alternatively lowered to a minimum height, as shown in FIGS. **9** and **14**.

The lateral or horizontal shift subassemblies **65** and **65'**, shown in FIGS. **5** and **15**, each include a pair of linear rails **76** or **76'** mounted on the inboard face of the respective plate **72** or **72'**. Corresponding linear bearings **77** and **77'** are mounted on the inboard wall of the housing **71** and **71'**. A nut carrier **81** or **81'** is attached to the back side of each of the plates **72** and **72'** in a horizontally threaded orientation for receiving a nut through which passes a lead or power screw **82** or **82'** that is driven by a motor **83** or **83'**. The motors **83**, **83'** each include a respective position sensing device or sensor **80**, **80'** (FIGS. **11** and **15**) that determines the lateral movement or shift of the plate **72** or **72'** and converts it to a code, which is transmitted to the computer **28**. The sensors **80**, **80'** are preferably rotary encoders as previously described and cooperate with home switches **80***a* and **80***a'* (FIGS. **5** and **15**).

Operation of the motors **83** and **83'** drives the respective screws **82** and **82'**, causing the nut carriers to advance along the screws **82** and **82'**, along with the plates **72** and **72'**, to which the nut carriers are attached. In this manner, the plates **72** and **72'** are shifted laterally with respect to the housings **71** and **71'**, which are thereby also shifted laterally with respect to a longitudinal axis of the patient support **1**. Reversal of the motors **83** and **83'** causes the plates **72** and **72'** to shift in a reverse lateral direction, enabling horizontal back-and-forth lateral or horizontal movement of the subassemblies **65** and **65'**. It is foreseen that a single one of the motors **83** or **83'** may be operated to shift a single one of the subassemblies **65** or **65'** in a lateral direction.

While a linear rail type lateral shift subassembly has been described, it is foreseen that a worm gear construction may also be used to achieve the same movement of the carrier plates **72** and **72'**.

The angulation and tilt or roll subassemblies **66** and **66'** shown in FIGS. **8**, **10**, **12** and **14**, each include a generally channel shaped rack **84** and **84'** (FIG. **7**) that is mounted on the inboard surface of the respective carrier plate **72** or **72'** of the horizontal shift subassembly **65** or **65'**. The racks **84** and **84'** each include a plurality of spaced apart apertures sized to receive a series of vertically spaced apart hitch pins **85** (FIG. **10**) and **85'** (FIG. **8**) that span the racks **84** and **84'** in a rung formation. The rack **84'** at the head end of the structure **1** is depicted in FIGS. **1** and **7** as being of somewhat shorter length than the rack **84** at the foot end, so that it does not impinge on the elbow **35** when the support assembly **6** is in the lowered position depicted in FIG. **7**. Each of the racks **84** and **84'**supports a main block **86** (FIG. **12**) or **86'** (FIG. **15**), which is laterally bored through at the top and bottom to receive a pair of hitch pins **85** or **85'**. The blocks **86** and **86'** each have an approximately rectangular footprint that is sized for reception within the channel walls of the racks by the pins **85** and **85'**.

The hitch pins **85** and **85'** hold the blocks **86** and **86'** in place on the racks, and enable them to be quickly and easily repositioned upwardly or downwardly on the racks **84** and **84'** at a variety of heights by removal of the pins **85** and **85'**, repositioning of the blocks, and reinsertion of the pins at the new locations.

Each of the blocks **86** and **86'** includes at its lower end a plurality of apertures **91** for receiving fasteners **92** that connect an actuator mounting plate **93** or **93'** to the block **86** or **86'** (FIGS. **12** and **14**). Each block also includes a channel or joint **94** and **94'** which serves as a universal joint for receiving the stem portion of the generally T-shaped yokes **95**, **95'** (FIGS. **7** and **12**). The walls of the channel as well as the stem portion of each of the yokes **95** and **95'** are bored through from front to back to receive a pivot pin **106** (FIG. **12**) that retains the stem of the yoke in place in the joint **94** or **94'** while permitting rotation of the yoke from side to side about the pin. The transverse portion of each of the yokes **95** and **95'** is also bored through along the length thereof.

Each of the yokes supports a generally U-shaped plate **96** and **96'** (FIGS. **12** and **8**) that in turn supports a respective one of the first and second patient supports **10** and **11** (FIGS. **3** and **12**). The U-shaped bottom plates **96** and **96'** each include a pair of spaced apart dependent inboard ears **105** and **105'** (FIGS. **8** and **12**). The ears are apertured to receive pivot pins **111** and **111'** that extend between the respective pairs of ears and through the transverse portion of the yoke to hold the yoke in place in spaced relation to a respective bottom plate **96** or **96'**. The bottom plate **96'** installed at the head end of the structure **1** further includes a pair of outboard ears **107** (FIG. **9**), for mounting the translator assembly **123**, as will be discussed in more detail.

The pivot pins **111** and **111'** enable the patient supports **10** and **11**, which are connected to respective bottom plates **96** and **96'**, to pivot upwardly and downwardly with respect to the yokes **95** and **95'**. In this manner, the angulation and roll or tilt subassemblies **66** and **66'** provide a mechanical articulation at the outboard end of each of the patient supports **10** and **11**. An additional articulation at the inboard end of each of the patient supports **10** and **11** will be discussed in more detail below.

As shown in FIG. **2**, each patient support or frame **10** and **11** is a generally U-shaped open framework with a pair of elongate, generally parallel spaced apart arms or support spars **101***a* and **101***b* and **101***a'* and **101***b'* extending inboard from a curved or bight portion at the outboard end. The patient support framework **10** at the foot end of the structure **1** is illustrated with longer spars than the spars of the framework **11** at the head end of the structure **1**, to accommodate the longer lower body of a patient. It is foreseen that all of the spars, and the patient support frameworks **10** and **11** may also be of equal length, or that the spars of framework **11** could be longer than the spars of framework **10**, so that the overall length of framework **11** will be greater than that of framework **10**. A cross brace **102** may be provided between the longer spars **101***a* and **101***b* at the foot end of the structure **1** to provide additional stability and support. The curved or bight portion of the outboard end of each framework is surmounted by an outboard or rear bracket **103** or **103'** which is connected to a respective supporting bottom plate **96** or **96'** by means of bolts or other suitable fasteners. Clamp style brackets **104***a* and **104***b* and **104***a'* and **104***b'* also surmount each of the spars **101***a* and **101***b* and **101***a'* and **101***b'* in spaced relation to the rear brackets **103** and **103'**. The clamp brackets are also fastened to the respective supporting bottom plates **96** and **96'** (FIGS. **1**, **10**). The inboard surface of each of the brackets **104***a* and **104***b* and **104***a'* and **104***b'* functions as an upper actuator mounting plate (FIG. **3**).

The angulation and roll subassemblies **66** and **66'** each further include a pair of linear actuators **112***a* and **112***b* and **112***a'* and **112***b'* (FIGS. **8** and **10**). Each actuator is connected at one end to a respective actuator mounting plate **93** or **93'** and at the other end to the inboard surface of one of the respective clamp brackets **104***a*, **104***b* or **104***a'*, **104***b'*. Each of the linear actuators is interfaced connected with the computer **28**. The actuators each include a fixed cover or housing containing a motor (not shown) that actuates a lift arm or rod **113***a* or **113***b* or **113***a'* or **113***b'* (FIGS. **12**, **14**). The actuators are connected by means of ball-type fittings **114**, which are connected with the bottom of each actuator and with the end of each lift arm. The lower ball fittings **114** are each connected to a respective actuator mounting plate **93** or **93'**, and the uppermost fittings **114** are each connected to the inboard surface of a respective clamp bracket **104***a* or **104***b* or **104***a'* or **104***b'*, all by means of a fastener **115** equipped with a washer **116** (FIG. **12**) to form a ball-type joint.

The linear actuators **112***a*, **112***b*, **112***a'*, **112***b'* each include an integral position sensing device (generally designated by a respective actuator reference numeral) that determines the position of the actuator, converts it to a code and transmits the code to the computer **28**. Since the linear actuators are connected with the spars **101***a,b* and **101***a,b'* via the brackets **104***a,b* and **104***a',b'*, the computer **28** can use the data to determine the angles of the respective spars. It is foreseen that respective home switches (not shown) as well as the position sensors may be incorporated into the actuator devices.

The angulation and roll mechanisms **66** and **66'** are operated by powering the actuators **112***a*, **112***b*, **112***a'* and **112***b'* using a switch or other similar means incorporated in the controller **29** for activation by an operator or by the computer **28**. Selective, coordinated operation of the actuators causes the lift arms **113***a* and **113***b* and **113***a'* and **113***b'* to move respective spars **101***a* and **101***b* and **101***a'* and **101***b'*. The lift arms can lift both spars on a patient support **10** or **11** equally so that the ears **105** and **105'** pivot about the pins **111** and **111'** on the yokes **95** and **95'**, causing the patient support **10** or **11** to angle upwardly or downwardly with respect to the bases **12** and **13** and connector rail **2**. By coordinated operation of the actuators **112***a*, **112***b* and **112***a'*, **112***b'* to extend and/or retract their respective lift arms, it is possible to achieve coordinated angulation of the patient supports **10** and **11** to an upward (FIG. **7**) or downward breaking position or to a planar angled position (FIG. **9**) or to differentially angle the patient supports **10** and **11** so that each support subtends a different angle, directed either upwardly or downwardly, with the floor surface below. As an exemplary embodiment, the linear actuators **112***a*, **112***b*, **112***a'* and **112***b'* may extend the ends of the spars **101***a*, **101***b*, **101***a'* and **101***b'* to subtend an upward angle of up to about 50° and to subtend a downward angle of up to about 30° from the horizontal.

It is also possible to differentially angle the spars of each support **10** and/or **11**, that is to say, to raise or lower spar **101***a* more than spar **101***b* and/or to raise or lower spar **101***a'* more than spare **101***b'*, so that the respective supports **10** and/or **11** may be caused to roll or tilt from side to side with respect to the longitudinal axis of the structure **1** as shown in FIGS. **7** and **8**. As an exemplary embodiment, the patient supports may be caused to roll or rotate clockwise about the longitudinal axis up to about 17° from a horizontal plane and counterclockwise about the longitudinal axis up to about 17° from a horizontal plane, thereby imparting to the patient supports **10** and **11***a* range of rotation or ability to roll or tilt about the longitudinal axis of up to about 34°.

As shown in FIG. **4**, the patient support **10** is equipped with a pair of hip or lumbar support pads **120***a*, **120***b* that are selectively positionable for supporting the hips of a patient and are held in place by a pair of clamp style brackets or hip pad mounts **121***a*, **121***b* that surmount the respective spars **101***a*, **101***b* in spaced relation to their outboard ends. Each of the mounts **121***a* and **121***b* is connected to a hip pad plate **122** (FIG. **4**) that extends medially at a downward angle. The hip pads **120** are thus supported at an angle that is pitched or directed toward the longitudinal center axis of the supported patient. It is foreseen that the plates could be pivotally adjustable rather than fixed.

The chest, shoulders, arms and head of the patient are supported by a trunk or torso translator assembly **123** (FIGS. **2**, **13**) that enables translational movement of the head and upper body of the supported patient along the second patient support **11** in both caudad and cephalad directions. The translational movement of the trunk translator **123** is coordinated with the upward and downward angulation of the inboard ends of the patient supports **10** and **11**. As best shown in FIG. **2**, the translator assembly **123** is of modular construction for convenient removal from the structure **1** and replacement as needed.

The translator assembly **123** is constructed as a removable component or module, and is shown in FIG. **13** disengaged and removed from the structure **1** and as viewed from the patient's head end. The translator assembly **123** includes a head support portion or trolley **124** that extends between and is supported by a pair of elongate support or trolley guides **125***a* and **125***b*. Each of the guides is sized and shaped to receive a portion of one of the spars **101***a*' and **101***b*' of the patient support **11**. The guides are preferably lubricated on their inner surfaces to facilitate shifting back and forth along the spars. The guides **125***a* and **125***b* are interconnected at their inboard ends by a crossbar, cross brace or rail **126** (FIG. **3**), which supports a sternum pad **127**. An arm rest support bracket **131***a* or **131***b* is connected to each of the trolley guides **125***a* and **125***b* (FIG. **13**). The support brackets have an approximately Y-shaped overall configuration. The downwardly extending end of each leg terminates in an expanded base **132***a* or **132***b*, so that the legs of the two brackets form a stand for supporting the trunk translator assembly **123** when it is removed from the table **1** (FIG. **2**). Each of the brackets **131***a* and **131***b* supports a respective arm rest **133***a* or **133***b*. It is foreseen that arm-supporting cradles or slings may be substituted for the arm rests **133***a* and **133***b*.

The trunk translator assembly **123** includes a pair of linear actuators **134***a*, **134***b* (FIG. **13**) that each include a motor **135***a* or **135***b*, a housing **136** and an extendable shaft **137**. The linear actuators **134***a* and **134***b* each include an integral position sensing device or sensor (generally designated by a respective actuator reference number) that determines the position of the actuator and converts it to a code, which it transmits to the computer **28** as previously described. Since the linear actuators are connected with the trunk translator assembly **123**, the computer **28** can use the data to determine the position of the trunk translator assembly **123** with respect to the spars **101***a*' and **101***b*'. It is also foreseen that each of the linear actuators may incorporate an integral home switch (generally designated by a respective actuator reference number).

Each of the trolley guides **125***a* and **125***b* includes a dependent flange **141** (FIG. **3**) for connection to the end of the shaft **137**. At the opposite end of each linear actuator **134**, the motor **135** and housing **136** are connected to a flange **142** (FIG. **13**) that includes a post for receiving a hitch pin **143**. The hitch pins extend through the posts as well as the outboard ears **107** (FIG. **9**) of the bottom plate **96'**, thereby demountably connecting the linear actuators **134***a* and **234***b* to the bottom plate **96'** (FIGS. **8**, **9**).

The translator assembly **123** is operated by powering the actuators **134***a* and **134***b* via integrated computer software actuation for automatic coordination with the operation of the angulation and roll or tilt subassemblies **66** and **66'** as well as the lateral shift subassemblies **66**, **66'**, the column lift assemblies **3**,**4**, vertical lift subassemblies **64**, **64'** and longitudinal shift subassembly **20**. The assembly **123** may also be operated by a user, by means of a switch or other similar means incorporated in the controller **29**.

Positioning of the translator assembly **123** is based on positional data collection by the computer in response to inputs by an operator. The assembly **123** is initially positioned or calibrated within the computer by a coordinated learning process and conventional trigonometric calculations. In this manner, the trunk translator assembly **123** is controlled to travel or move a distance corresponding to the change in overall length of the base of a triangle formed when the inboard ends of the patient supports **10** and **11** are angled upwardly or downwardly. The base of the triangle equals the distance between the outboard ends of the patient supports **10** and **11**. It is shortened by the action of the translation subassembly **20** as the inboard ends are angled upwardly and downwardly in order to maintain the inboard ends in proximate relation. The distance of travel of the translation assembly **123** may be calibrated to be identical to the change in distance between the outboard ends of the patient supports, or it may be approximately the same. The positions of the supports **10** and **11** are measured as they are raised and lowered, the assembly **123** is positioned accordingly and the position of the assembly is measured. The data points thus empirically obtained are then programmed into the computer **28**. The computer **28** also collects and processes positional data regarding longitudinal translation, height from both the column assemblies **3** and **4** and the secondary lift assemblies **73**, **73'**, lateral shift, and tilt orientation from the sensors **27**, **47**, **47'**, **78**, **78'**, **80**, **80'**, and **112***a*, **112***b* and **112***a*', **112***b*'. Once the trunk translator assembly **123** is calibrated using the collected data points, the computer **28** uses these data parameters to processes positional data regarding angular orientation received from the sensors **112***a*, **112***b*, **112***a*', **112***b*' and feedback from the trunk translator sensors **134***a*, **134***b* to determine the coordinated operation of the motors **135***a* and **135***b* of the linear actuators **134***a*, **134***b*.

The actuators drive the trolley guides **125***a* and **125***b* supporting the trolley **124**, sternum pad **127** and arm rests **133***a* and **133***b* back and forth along the spars **101***a*' **101***b*' in coordinated movement with the spars **101***a*, **101***b*, **101***a*' and **101***b*'. By coordinated operation of the actuators **134***a* and **134***b* with the angular orientation of the supports **10** and **11**, the trolley **124** and associated structures are moved or translated in a caudad direction, traveling along the spars **101***a*' and **101***b*' toward the inboard articulation of the patient support **11**, in the direction of the patient's feet when the ends of the spars are raised to an upwardly breaking angle (FIG. **7**), thereby avoiding excessive traction on the patient's spine. Conversely, by reverse operation of the actuators **134***a* and **134***b*, the trolley **124** and associated structures are moved or translated in a cephalad direction, traveling along the spars **101***a*', **101***b*' toward the outboard articulation of the patient support **11**, in the direction of the patient's head when the ends of the spars are lowered to a downwardly breaking angle, thereby avoiding excessive compression of the patient's spine. It is foreseen that the operation of the actuators may also be coordinated with the tilt orientation of the supports **10** and **11**.

When not in use, the translator assembly **123** can be easily removed by pulling out the hitch pins **143** and disconnecting the electrical connection (not shown). As shown in FIG. **11**, when the translator assembly **123** is removed, planar patient support elements such as imaging tops **144** and **144'** may be installed atop the spars **101***a*, **101***b* and **101***a*', **101***b*' respectively. It is foreseen that only one planar element may be mounted atop spars **101***a*, **101***b* or **101***a*', **101***b*', so that a planar support element **144** or **144'** may be used in combination with either the hip pads **120***a* and **120***b* or the translator assembly **123**. It is also foreseen that the translator assembly support guides **125***a* and **125***b* may be modified for reception of the lateral margins of the planar support **144'** to permit use of the translator assembly in association with the planar support **144'**. It is also foreseen that the virtual, open or non-joined articulation of the inboard ends of the illustrated patient support spars **101***a,b* and **101***a',b*' or the inboard ends of the planar support elements **144** and **144'** without a mechanical connection may alternatively be mechanically articulated by means of a hinge connection or other suitable element.

In use, the trunk translator assembly **123** is preferably installed on the patient supports **10** and **11** by sliding the support guides **125***a* and **125***b* over the ends of the spars **101***a*' and **101***b*' with the sternum pad **127** oriented toward the center of the patient positioning support structure **1** and the arm rests **133***a* and **133***b* extending toward the second support assembly **6**. The translator **123** is slid toward the head end until the flanges **142** contact the outboard ears **107** of the bottom plate **96'** and their respective apertures are aligned. The hitch pin **143** is inserted into the aligned apertures to secure the translator **123** to the bottom plate **96'** which supports the spars **101***a*' and **101***b*' and the electrical connection for the motors **135** is made.

The patient supports **10** and **11** may be positioned in a horizontal or other convenient orientation and height to facilitate transfer of a patient onto the translator assembly **123** and support surface **10**. The patient may be positioned, for example, in a generally prone position with the head supported on the trolley **124**, and the torso and arms supported on the sternum pad **127** and arm supports **133***a* and **133***b* respectively. A head support pad may also be provided atop the trolley **124** if desired.

The patient may be raised or lowered in a generally horizontal position (FIGS. **1**, **2**) or in a feet-up or head-up orientation (FIGS. **9**, **14**) by actuation of the lift arm segments of the column assemblies **3** and **4** and/or the vertical lift subassemblies **64** and/or **64'** in the manner previously described. At the same time, either or both of the patient supports **10** and **11** (with attached translator assembly **123**) may be independently shifted laterally by actuation of the lateral shift subassemblies **65** and/or **65'**, either toward or away from the longitudinal side of the structure **1** as illustrated in FIGS. 32 and 33 of Applicant's U.S. Pat. No. 7,343,635, the disclosure of which patent is incorporated herein by reference. Also at the same time, either or both of the patient supports **10** and **11** (with attached translator assembly **123**) may be independently rotated by actuation of the angulation and roll or tilt subassembly **66** and/or **66'** to roll or tilt from side to side (FIGS. **7**, **8** and **15**). Simultaneously, either or both of the patient supports **10** and **11** (with attached translator assembly **123**) may be independently angled upwardly or downwardly with respect to the base members **12** and **13** and rail **2**. It is also foreseen that the patient may be positioned in a 90°/90° kneeling prone position as depicted in FIG. 26 of U.S. Pat. No. 7,343,635 by selective actuation of the lift arm segments of the column lift assemblies **3** and **4** and/or the secondary vertical lift subassemblies **64** and/or **64'** as previously described.

When the patient supports **10** and **11** are positioned to a lowered, laterally tilted position, with the inboard ends of the patient supports in an upward breaking angled position, as depicted in FIG. **7**, causing the spine of the supported patient to flex, the height sensors **47**, **47'** and **78**, **78'** and integral position sensors in the linear actuators **112***a*,**112***b* and **112***a*', **112***b*' convey information or data regarding height, tilt orientation and angular orientation to the computer **28** for automatic actuation of the translator assembly **123** to shift the trolley **124** and associated structures from the position depicted in FIG. **1** so that the ends of the support guides **125***a* and **125***b* are slidingly shifted toward the inboard ends of the spars **101***a*' and **101***b*' as shown in FIG. **7**. This enables the patient's head, torso and arms to shift in a caudad direction, toward the feet, thereby relieving excessive traction along the spine of the patient. Similarly, when the patient supports **10** and **11** are positioned with the inboard ends in a downward breaking angled position, causing compression of the spine of the patient, the sensors convey data regarding height, tilt, orientation and angular orientation to the computer **28** for shifting of the trolley **124** away from the inboard ends of the spars **101***a*' and **101***b*'. This enables the patient's head, torso and arms to shift in a cephalad direction, toward the head, thereby relieving excessive compression along the spine of the patient.

By coordinating or coupling the movement of the trunk translator assembly **123** with the angulation and tilt of the patient supports **10** and **11**, the patient's upper body is able to slide along the patient support **11** to maintain proper spinal biomechanics during a surgical or medical procedure.

The computer **28** also uses the data collected from the position sensing devices **27**, **47**, **47'**, **78**, **78'**, **80**, **80'**, **112***a*, **112***b*, **112***a*', **112***b*', and **134***a*, **134***b* as previously described to coordinate the actions of the longitudinal translation subassembly **20**. The subassembly **20** adjusts the overall length of the table structure **1** to compensate for the actions of the support column lift assemblies **3** and **4**, horizontal support assemblies **5** and **6**, secondary vertical lift subassemblies **64** and **64'**, horizontal shift subassemblies **65** and **65'**, and angulation and roll or tilt subassemblies **66** and **66'**. In this manner the distance D between the ends of the spars **101***a* and **101***a*' and the distance D' between the ends of the spars **101***b* and **101***b*' may be continuously adjusted during all of the aforementioned raising, lowering, lateral shifting, rolling or tilting and angulation of the patient supports **10** and **11**. The distances D and D' may be maintained at preselected or fixed values or they may be repositioned as needed. Thus, the inboard ends of the patient supports **10** and **11** may be maintained in adjacent, closely spaced or other spaced relation or they may be selectively repositioned. It is foreseen that the distance D and the distance D' may be equal or unequal, and that they may be independently variable.

Use of this coordination and cooperation to control the distances D and D' serves to provide a non-joined or mechanically unconnected inboard articulation at the inboard end of each of the patient supports **10** and **11**. Unlike the mechanical articulations at the outboard end of each of the patient supports **10** and **11**, this inboard articulation of the structure **1** is a virtual articulation that provides a movable pivot axis or joint between the patient supports **10** and **11** that is derived from the coordination and cooperation of the previously described mechanical elements, without an actual mechanical pivot connection or joint between the inboard ends of the patient supports **10** and **11**. The ends of the spars **101***a*, **101***b* and **101***a*', **101***b*' thus remain as fee ends, which are not connected by any mechanical element. However, through the cooperation of elements previously described, they are enabled to function as if connected. It is also foreseen that the inboard articulation may be a mechanical articulation such as a hinge.

Such coordination may be by means of operator actuation using the controller **29** in conjunction with integrated computer software actuation, or the computer **28** may automatically coordinate all of these movements in accordance with preprogrammed parameters or values and data received from the position sensors **27**, **47**, **47**', **78**, **78**', **80**, **80**', **117***a*, **117***b*, **117***a*', **117***b*', and **138***a*, **138***b*.

A second embodiment of the patient positioning support structure is generally designated by the reference numeral **200**, and is depicted in FIGS. **16-20**. The structure **200** is substantially similar to the structure **1** shown in FIGS. **1-15** and includes first and second patient supports **205** and **206**, each having an inboard end interconnected by a hinge joint **203**, including suitable pivot connectors such as the illustrated hinge pins **204**. Each of the patient supports **205** and **206** includes a pair of spars **201**, and the spars **201** of the second patient support **206** support a patient trunk translation assembly **223**.

The trunk translator **223** is engaged with the patient support **206** and is substantially as previously described and shown, except that it is connected to the hinge joint **203** by a linkage **234**. The linkage is connected to the hinge joint **203** in such a manner as to position the trunk translator **223** along the patient support **206** in response to relative movement of the patient supports **205** and **206** when the patient supports are positioned in a plurality of angular orientations.

In use, the a trunk translator **223** is engaged the patient support **206** and is slidingly shifted toward the hinge joint **203** as shown in FIG. **19** in response to upward angulation of the patient support. This enables the patient's head, torso and arms to shift in a caudad direction, toward the feet. The trunk translator **223** is movable away from the hinge joint **203** as shown in FIG. **17** in response to downward angulation of the patient support **206**. This enables the patient's head, torso and arms to shift in a cephalad direction, toward the head.

It is foreseen that the linkage may be a control rod, cable (FIG. **20**) or that it may be an actuator **234** as shown in FIG. **17**, operable for selective positioning of the trunk translator **223** along the patient support **206**. The actuator **234** is interfaced with a computer **28**, which receives angular orientation data from sensors as previously described and sends a control signal to the actuator **234** in response to changes in the angular orientation to coordinate a position of the trunk translator with the angular orientation of the patient support **206**. Where the linkage is a control rod or cable, the movement of the trunk translator **223** is mechanically coordinated with the angular orientation of the patient support **206** by the rod or cable.

It is to be understood that while certain forms of the patient positioning support structure have been illustrated and described herein, the structure is not to be limited to the specific forms or arrangement of parts described and shown.

The following is claimed and desired to be secured by Letters Patent:

1. An apparatus for supporting and positioning a patient during a medical procedure, the apparatus comprising:

a) first and second opposed end supports;

b) first and second patient supports, each having inboard ends and outboard ends and aligned to extend between the end supports;

c) said outboard ends of said patient support each having an outboard articulation with a respective one of said end supports;

d) said inboard portion of said patient support having an inboard articulation;

e) the first end support includes an angulation mechanism operable to selectively position the first patient support in a plurality of angular orientations with respect to the second patient support; and

f) the apparatus having a powered horizontal translation compensation mechanism to provide for length adjustment in coordination with operation of said angulation mechanism.

2. The apparatus of claim **1**, wherein:

a) said articulation of said outboard ends of said patient support with said end supports is by respective pivotal connections.

3. The apparatus of claim **1**, wherein:

a) said inboard portion of said patient support includes a pair of inboard ends; and

b) said inboard articulation includes a hinge joint between said inboard ends.

4. The apparatus of claim **1**, wherein:

a) said first and second end supports surmount respective first and second base members; and

b) one of said first and second base members is connected to said powered horizontal translation compensation mechanism.

5. The apparatus of claim **1**, wherein the first end support further includes:

a) a base member having an upper portion and a lower portion;

b) a column member upstanding from said base upper portion and connected with one of said first and second patient support outer ends; and

c) a longitudinal shift mechanism operable to shift said base upper portion toward and away from the other of said end supports.

6. An apparatus for supporting and positioning a patient during a medical procedure, the apparatus comprising:

a) first and second opposed end supports;

b) a patient support extending between said first and second end supports, said patient support having a pair of outboard ends and an inboard portion;

c) said outboard ends of said patient support each having an outboard articulation with a respective one of said end supports;

d) said inboard portion of said patient support having an inboard articulation;

e) the first end support includes an angulation mechanism operable to selectively position said patient support in a plurality of angular orientations with respect to the other patient support structure;

f) a longitudinal translation compensation mechanism operable to selectively shift said first end support toward and away from said second end support in coordination with operation of said angulation mechanism, wherein said first and second end supports surmount respective first and second base members; and one of said first and second base members is connected to said longitudinal translation compensation mechanism;

g) a rail connecting said first and second end supports; and

h) said longitudinal translation compensation mechanism operating to shift a portion of one of said first and second base members relative to said rail to thereby vary a distance between said first and second end supports.

7. The apparatus of claim 6, wherein:
a) said angulation mechanism including angle sensors sensing angular orientations of said patient supports;
b) a computer is interfaced with said angle sensors;
c) said angle sensors transmitting data regarding said angular orientations of said patient supports to said computer; and
d) said computer controlling actuation of said longitudinal translation compensation mechanism in coordination with said angular orientations sensed by said angle sensors.

8. The apparatus of claim 7, wherein the first end support includes a lateral shifting mechanism connected with one of said patient support outer ends.

9. The apparatus of claim 7, wherein said end support further includes:
a) a vertical support column including a plurality of lift arm segments operable to selectively raise and lower said support column;
b) a horizontal support member shiftably mounted on said column;
c) said horizontal support member connected with said lateral shifting mechanism and said angulation mechanism; and
d) said horizontal support member including a secondary lift mechanism operable for selected shifting upwardly and downwardly on said column for maximum selective raising and lowering of said lateral shifting mechanism and said angulation mechanism.

10. An apparatus for supporting a patient during a medical procedure, the apparatus comprising:
a) first and second opposed end supports;
c) first and second patient supports, each having an outer end pivotally connected with a respective end support and an inner free end;
d) the first end support including an articulation mechanism for selectively raising, lowering, rotating, lateral shifting and angulation of a respective one of said patient supports;
e) a trunk translator slidably connected with one of said patient supports to enable movement of the upper body of a patient back and forth along a longitudinal axis of said patient supports when the free ends of said patient supports are angled upwardly and downwardly; and
f) a connector rail connecting said end supports, said connector rail having a first end connected with said first end support and a second end connected with said second end support, one of said rail ends having a translation compensation mechanism selectively moving said connected end support to maintain a preselected distance between said free ends of said patient supports as they move throughout various angular orientations thereof.

11. An apparatus for supporting, positioning, and articulating a patient during a surgical procedure, the apparatus comprising:
a) a base having spaced opposed first and second column support assemblies;
b) a breaking patient support;
c) a connection subassembly joining the first and second column support assemblies with the breaking patient support, whereby the breaking patient support is supported by the base;
d) an actuation subassembly operable to provide coordinated lift, angulation, and roll of the breaking patient support with respect to the base, whereby a portion of said breaking patient support is selectively positioned in a plurality of angular orientation with respect to the base;
e) a powered translation compensation mechanism to provide for length adjustment in cooperation with the breaking patient support;
f) a trunk translator engaged with an upper body support portion of the breaking patient support; and
g) a trunk actuator operable for selective coordinated positioning of the trunk translator along the upper body support portion in response to change in an angular orientation between the upper body support portion and a lower body support portion of the patient support.

12. The apparatus of claim 11, wherein:
a) the actuation subassembly is further operable to provide translation compensation of the breaking patient support with respect to the base.

13. The apparatus of claim 11, wherein:
a) one of the group of: the base, the breaking patient support, and the connection subassembly includes a portion of the actuation subassembly.

14. The apparatus of claim 11, wherein:
a) the actuation subassembly includes:
i) a lift mechanism with a height sensor for sensing and transmitting a height of an end of the breaking patient support with respect to the base;
ii) a roll mechanism with a tilt sensor for sensing and transmitting a tilt orientation of the breaking patient support with respect to the base;
iv) an angulation mechanism with an angle sensor for sensing and transmitting said angular orientation of the breaking patient support with respect to the base; and
v) a translation compensation mechanism with a translation sensor for sensing and transmitting end position data indicating relative positions of outboard ends of the breaking patient support; and
b) a computer is interfaced with the actuation subassembly, the mechanisms and the sensors for receiving height data, angular orientation, tilt orientation, and end position data to thereby coordinate operation of said translation compensation mechanism with said lifting operations, angular orientation and tilt orientation.

15. The apparatus according to claim 14, wherein:
a) the breaking patient support and the connection subassembly includes a portion of the translation compensation mechanism.

16. The apparatus of claim 11, wherein:
a) the base includes a lateral shifting mechanism operable to position a portion of the breaking patient support in a plurality of lateral positions with respect to a respective column support assembly.

17. The apparatus of claim 11, wherein:
a) the breaking patient support includes upper and lower body support portions with inboard and outboard ends, the inboard ends being located adjacent to one another;
b) each of the body support portions is operably positionable in a plurality of selectable angular orientations with respect to the base; and
c) the inboard ends are positioned at selected distance from one another.

18. The apparatus of claim 17, wherein:
a) one of the upper and lower body support portions is cantilevered.

19. The apparatus of claim 17, wherein:
a) the upper and lower body support portions are joined by a hinge at their inboard ends.

20. The apparatus of claim 19, the apparatus further including:

a) the trunk actuator joining the hinge with the trunk translator so as to selectively coordinate positioning of the trunk translator along the upper body support portion in response to changes in the angular orientation of the hinge.

21. The apparatus of claim 19, wherein:

a) the trunk actuator includes a linkage structure joining the hinge with the trunk translator, whereby the position of the hinge is coordinated with the position of the trunk translator.

22. The apparatus of claim 19, wherein:

a) the trunk actuator includes a position sensor electronically connected to a processor, the trunk actuator joining the hinge with the trunk translator, whereby the position of the hinge is transmitted to a processor along with the position of the trunk translator.

23. The apparatus of claim 11, wherein:

a) each of the first and second column support assemblies includes a primary elevator.

24. The apparatus of claim 23, wherein:

a) the first column support assembly includes a secondary elevator.

25. An apparatus for supporting and positioning a patient during a medical procedure, the apparatus comprising:

a) a base having spaced opposed first and second end supports to elevate an end of an elongate patient support structure configured for prone patient positioning with pads;

b) the elongate patient support structure having two sections that are articulated by a pair of spaced opposed hinges; and

c) the base end support connected to the two sections by connection subassemblies and configured with actuation subassemblies to articulate and angulate the sections relative to each other, wherein the hinges are solely and passively moved by the base connection subassemblies; wherein

d) one section has an attached patient support pad on one side of the pair of hinges and the other section has another patient support pad attached to a trunk translator on an opposite side of the pair of hinges, so as to allow for a belly of a patient to be located and suspended therebetween, when the pads angulate with their respective sections and relative to each other.

26. An apparatus for supporting and positioning a patient during a medical procedure, the apparatus comprising:

a) first and second opposed end supports;

b) a patient support extending between said first and second end supports, said patient support having a pair of outboard ends and an inboard portion;

c) said outboard ends of said patient support each having an outboard articulation with a respective one of said end supports;

d) said inboard portion of said patient support having a pair of inboard ends, the inboard ends having an articulation made up of a pair of spaced apart hinge mechanisms;

e) the first end support including an angulation mechanism operable to selectively position said patient support in a plurality of angular orientations with respect to the other patient support structure;

f) a powered longitudinal translation compensation mechanism to provide horizontal length adjustment for the apparatus in coordination with operation of said angulation mechanism.

27. An apparatus for supporting and positioning a patient during a medical procedure, the apparatus comprising:

a) first and second opposed end supports;

b) a patient support extending between said first and second end supports, said patient support having a pair of outboard ends and an inboard portion;

c) said outboard ends of said patient support each having an outboard articulation with a respective one of said end supports;

d) said inboard portion of said patient support having an inboard articulation;

e) the first end support including an angulation mechanism operable to selectively position said patient support in a plurality of angular orientations with respect to the other patient support structure;

f) a longitudinal translation compensation mechanism operable to selectively shift said first end support toward and away from said second end support in coordination with operation of said angulation mechanism; and

g) a trunk translator engaged with said patient support and movable toward said inboard articulation in response to upward angulation of said patient support and movable away from said inboard articulation in response to downward angulation of said patient support.

28. An apparatus for supporting and positioning a patient during a medical procedure, the apparatus comprising:

a) first and second opposed end supports;

b) a patient support extending between said first and second end supports, said patient support having a pair of outboard ends and an inboard portion;

c) said outboard ends of said patient support each having an outboard articulation with a respective one of said end supports;

d) said inboard portion of said patient support having an inboard articulation;

e) the first end support includes an angulation mechanism operable to selectively position said patient support in a plurality of angular orientations with respect to the other patient support structure; and

f) a trunk translator and actuator arm engaged with said patient support and the trunk translator and actuator arm movable toward said inboard articulation in response to upward angulation of said patient support and movable away from said inboard articulation in response to downward angulation of said patient support.

29. An apparatus for supporting a patient during a surgical procedure, the apparatus comprising:

a) an elongate base with a first outward lower portion located under a foot end support extending upwardly above a floor and a second outward lower portion located under a head end support extending upwardly above the floor, the upwardly extending end supports configured to provide for height adjustments with respect to the floor;

b) the base first and second outward lower portions being a fixed distance apart at opposite ends of the base when in use, the base having structure to partially engage the floor;

c) a patient support structure having opposed outer ends and extending between and connected to the foot and head end supports at the outer ends and positionable in a plurality of angular orientations above and with respect to the floor; and

d) a motorized translation compensation mechanism supported by the foot end support to provide for controlled length adjustment so that the base first and second outward lower portions supported by the floor remain a fixed distance apart when the outer ends of the patient support structure are independently raised and lowered with respect to the floor.

30. The apparatus of claim **29**, wherein the patient support structure has a first and second section connected by a pair of spaced apart hinges.

31. The apparatus of claim **30**, wherein the patient support structure further includes a trunk translator.

32. An apparatus for supporting a patient during a medical procedure, the apparatus comprising:

a) a base with first and second opposed end supports, each end support including a connection subassembly;

b) first and second patient supports, each having an outer end pivotally connected to a respective end support and an opposed inner end, each outer end being joined with one of said first and second end supports by a respective connection subassembly, and said inner ends being located adjacent to one another;

c) said base including structure operable to provide selectable and coordinated lift, angulation and roll of at least one of said first and second patient supports, whereby said patient supports are positionable in a plurality of selectable angular orientations with respect to said base and said first patient support inner end being positioned at a selected distance from said second patient support inner end;

d) at least one of said first and second end supports including a lift mechanism operable to raise and lower a respective patient support, an angulation mechanism operable to position one of the patient supports in a plurality of angular orientations with respect to a respective end support and a roll mechanism operable to tilt a respective patient support;

e) a motorized longitudinal translation compensation mechanism operable to maintain said patient support inner ends at said selected distance; and

f) a trunk translator engaged with one of said first and second patient supports, the trunk translator having a trunk actuator engaged with the same patient support as the trunk translator and operable for selective coordinated positioning of said trunk translator along said patient support in response to a change in said angular orientation to thereby coordinate a position of said trunk translator with said angular orientation.

33. An apparatus for supporting a patient during a medical procedure, the apparatus comprising:

a) first and second opposed end supports;

b) first and second patient supports, each patient support having an outer end connected to a respective end support and an opposed inner end;

c) said first patient support inner end being positioned at a selected distance from said second patient support inner end;

d) at least one of said first and second end supports including

i) a lift mechanism operable to raise and lower a respective patient support,

ii) an angulation mechanism operable to position one of the patient supports in a plurality of angular orientations with respect to a respective end support, such that the inner ends can angulate upwardly with an apex directed away from a floor and downwardly with an apex directed toward the floor support,

iii) a roll mechanism operable to tilt a respective patient support, and

iv) a powered longitudinal translation compensation mechanism operable for selective positioning of said patient supports in response to a change in said angular orientation to thereby maintain said patient support inner ends at said selected distance; and

e) a trunk translator and a trunk translator actuator engaged with one of said first and second patient supports, the trunk translator actuator selectively moving the trunk translator toward the apex when the patient supports angulate upwardly and selectively moving away from the apex when the patient supports angulate downwardly, wherein the trunk translator and trunk translator actuator move in the same direction.

34. The patient support apparatus as set forth in claim **20**, wherein:

a) said first and second patient support inner ends are connected by a pair of spaced apart hinge members.

35. An apparatus for supporting and positioning a patient during a medical procedure, the apparatus comprising:

a) a base having spaced opposed first and second end supports to elevate an end of an elongate patient support structure configured for prone patient positioning with pads;

b) the elongate patient support structure having two sections that are connected by a pair of spaced opposed hinges; and

c) the base end support connected to the two sections by connection subassemblies and configured with actuation subassemblies to articulate and angulate the sections relative to each other, wherein the hinges are solely and passively moved by the base connection subassemblies; wherein

d) one section has an attached patient support pad on one side of the pair of hinges and the other section has another attached patient support pad on an opposite side of the pair of hinges, so as to allow for a belly of a patient to be located and suspended therebetween, when the pads angulate with their respective sections and relative to each other, and wherein the apparatus has a powered translation compensation mechanism for horizontal length adjustment.

36. An apparatus for supporting a patient during a medical procedure, the apparatus comprising:

a) a base with first and second opposed end supports, each end support including a connection subassembly;

b) first and second patient supports, each having an outer end pivotally connected to a respective end support and an opposed inner end, each outer end being joined with one of said first and second end supports by a respective connection subassembly, and said inner ends being located adjacent to one another;

c) said base including structure operable to provide selectable and coordinated lift, angulation and roll of at least one of said first and second patient supports, whereby said patient supports are positionable in a plurality of selectable angular orientations with respect to said base and said first patient support inner end being positioned at a selected distance from said second patient support inner end;

d) at least one of said first and second end supports including a lift mechanism operable to raise and lower a respective patient support, an angulation mechanism operable to position one of the patient supports in a plurality of angular orientations with respect to a respective end support and a roll mechanism operable to tilt a respective patient support; and

e) a trunk translator engaged with one of said first and second patient supports, the trunk translator having a trunk actuator operable for selective coordinated positioning of said trunk translator along said patient support in response to a change in said angular orientation to thereby coordinate a position of said trunk translator with said angular orientation, wherein said actuator is located near and secured to the patient support outer end portion.

37. An apparatus for supporting and positioning a patient above a floor during a medical procedure, the apparatus comprising:

a) a base structure including first and second opposed end supports supported on a lower portion of the base structure, the lower portion including first and second outer lower portions supported by the floor and a fixed rail extending between the first and second outer lower portions, the first and second outer lower portions being a fixed distance apart;

b) first and second patient supports, each having an inboard portion and an outboard portion and the inboard and outboard portions aligned along a length thereof to extend between the end supports;

c) the outboard portions of the first and second patient supports each having an outboard articulation connections with a respective one of said end supports;

d) the inboard portions of the first and second patient supports each having an inboard articulation connection;

e) the first end support includes an angulation mechanism operable to selectively position the first patient support in a plurality of angular orientations with respect to the second patient support; and

f) a powered translation compensation mechanism located in the base structure and configured to provide for length adjustment of the patient supports in coordination with operation of said angulation mechanism.

38. The apparatus of claim **37**, wherein the translation compensation mechanism moves horizontally towards or away from the opposed end support.

39. An apparatus for supporting a patient during a medical procedure, the apparatus comprising:

a) first and second opposed end supports;

c) first and second patient supports, each having an outer end pivotally connected with a respective end support and an inner free end connected by a pair of spaced apart hinges in a traverse direction;

d) the first end support including an articulation mechanism for selectively raising, lowering, rotating, and angulating a respective one of said patient supports; and

e) a trunk translator slidably connected with one of said patient supports to enable movement of the upper body of a patient back and forth along a longitudinal axis of said patient supports when the patient supports are angled upwardly and downwardly.

40. The apparatus of claim **39**, wherein the trunk translator is moved by actuator, the actuator being controlled by a computer and independent of the hinges.

41. An apparatus for supporting, positioning, and articulating a patient during a surgical procedure, the apparatus comprising:

a) a base having spaced opposed first and second column support assemblies;

b) a breaking patient support including an inward articulation between upper and lower body support portions;

c) a connection subassembly joining the first and second column support assemblies with the breaking patient support, whereby the breaking patient support is supported by the base;

d) an actuation subassembly operable to provide coordinated lift, angulation, and roll of the breaking patient support with respect to the base, whereby a portion of said breaking patient support is selectively positioned in a plurality of angular orientation with respect to the base;

e) a powered translation compensation mechanism to provide for length adjustment in the direction of the column support assemblies in cooperation with the breaking patient support;

f) a trunk translator engaged with the upper body support portion of the breaking patient support; and

g) a trunk actuator operable for selective coordinated positioning of the trunk translator along the upper body support portion in response to change in an angular orientation between the upper body support portion and the lower body support portion of the patient support.

42. An apparatus for supporting and positioning a patient having an upper body during a medical procedure, the apparatus comprising:

a) a first end support and a second end support opposing the first end support;

b) a patient support structure extending between the first and second end supports and including a first patient support and a second patient support, each of the first and second patient supports having inboard ends and outboard ends, the outboard ends of the first and second patient supports each having an outboard articulation with a respective one of said end supports, the inboard ends of the first and second patient supports forming an articulation such that the first and second patient supports are configured to pivot relative to each other;

e) the first end support includes an angulation mechanism operable to selectively position the first patient support in a plurality of angular orientations with respect to the second patient support; and

f) a trunk translator slidably connected at a respective outboard end of one of the first or second patient supports, the trunk translator configured to provide for translational movement of the upper body of the patient back and forth along a longitudinal axis of the one of the first or second patient supports when the inner ends of said patient supports are angled at the articulation in coordination with operation of said angulation mechanism, the translational movement being disconnected from the movement of the first and second patient support at the articulation.

43. The apparatus of claim **42**, wherein the inboard ends are non-joined.

44. The apparatus of claim **42**, further comprises a linkage between the trunk translator and the respective outboard end of the one of the first or second patient supports.

45. The apparatus of claim **42**, wherein the first and second patient supports are configured to passively pivot relative to each other.

46. An apparatus for supporting and positioning a patient having an upper body during a medical procedure, the apparatus comprising:

a) a first end support and a second end support opposing the first end support;

b) a patient support structure extending between the first and second end supports and including a first patient support and a second patient support, each of the first and second patient supports having inboard ends and outboard ends, the outboard ends of the first and second patient supports each having an outboard articulation with a respective one of said end supports, the inboard ends of the first and second patient supports forming an articulation such that the first and second patient supports are configured to pivot relative to each other;

e) the first end support includes an angulation mechanism operable to selectively position the first patient support in a plurality of angular orientations with respect to the second patient support; and

f) a trunk translator slidably connected at a respective outboard end of one of the first or second patient supports, the trunk translator configured to provide for translational movement of the upper body of the patient back and forth along a longitudinal axis of the one of the first or second patient supports when the inner ends of said patient supports are angled at the articulation in coordination with operation of said angulation mechanism, the translational movement being independently controlled from the movement of the first and second patient support at the articulation.

47. The apparatus of claim **46**, wherein the inboard ends are non-joined.

48. The apparatus of claim **46**, further comprises a linkage between the trunk translator and the respective outboard end of the one of the first or second patient supports.

49. The apparatus of claim **46**, wherein the first and second patient supports are configured to passively pivot relative to each other.

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